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FRUITING BRANCH OF MANGOSTEEN

The glossy green leaves are not unlike those of the familiar rubber plant. The tree, like most trees in the tropics, retains its leaves throughout the year. Photograph from a water color sketch by Miss D. G. Passmore. (Frontispiece.)

THE MANGOSTEEN

"Queen of Fruits" Now Almost Confined to Malayan Archipelago, But Can Be Acclimated in Many Parts of Tropics—Experiments in America—Desirability of Widespread Cultivation.

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ONE of the first questions which a traveller in the Malay Archipelago may expect old residents to ask him, is, "Have you eaten a mangosteen?" If he has not, he may then expect to hear an enthusiastic description, more or less vague, of the deliciousness of what has justly been called the "queen of fruits."

It is a mistake to think that you have only to cross the line into the oriental tropics to have bunches and basketfuls of this fruit offered to you at the ridiculously low price of Eastern Shore peaches in the height of the season. Outside of the Straits Settlements, Java, Sumatra and the Moluccas the fruit is a rare one and as much sought after by the resident of the country as it is by the visitor.

It is not difficult for one who has tasted it to understand why the mangosteen is such a general favorite, although to give someone else an idea of its qualities is by no means an easy task.

There are many people who never acquire a taste for any of the fruits of the tropics. The Prussian finds them insipid in comparison with his plums and prunes, and the wall peaches of Kent are considered by the English as immeasurably superior. Tropical fruits are often stigmatized as insipid, resinous, mawkish, or too sweet. There are, it is true, many which are open to these objections, but it must be remembered that most of the fruits of the tropical zone are ungrafted seedlings analagous to our wild apples; and the wonder is that they prove as good as they do.

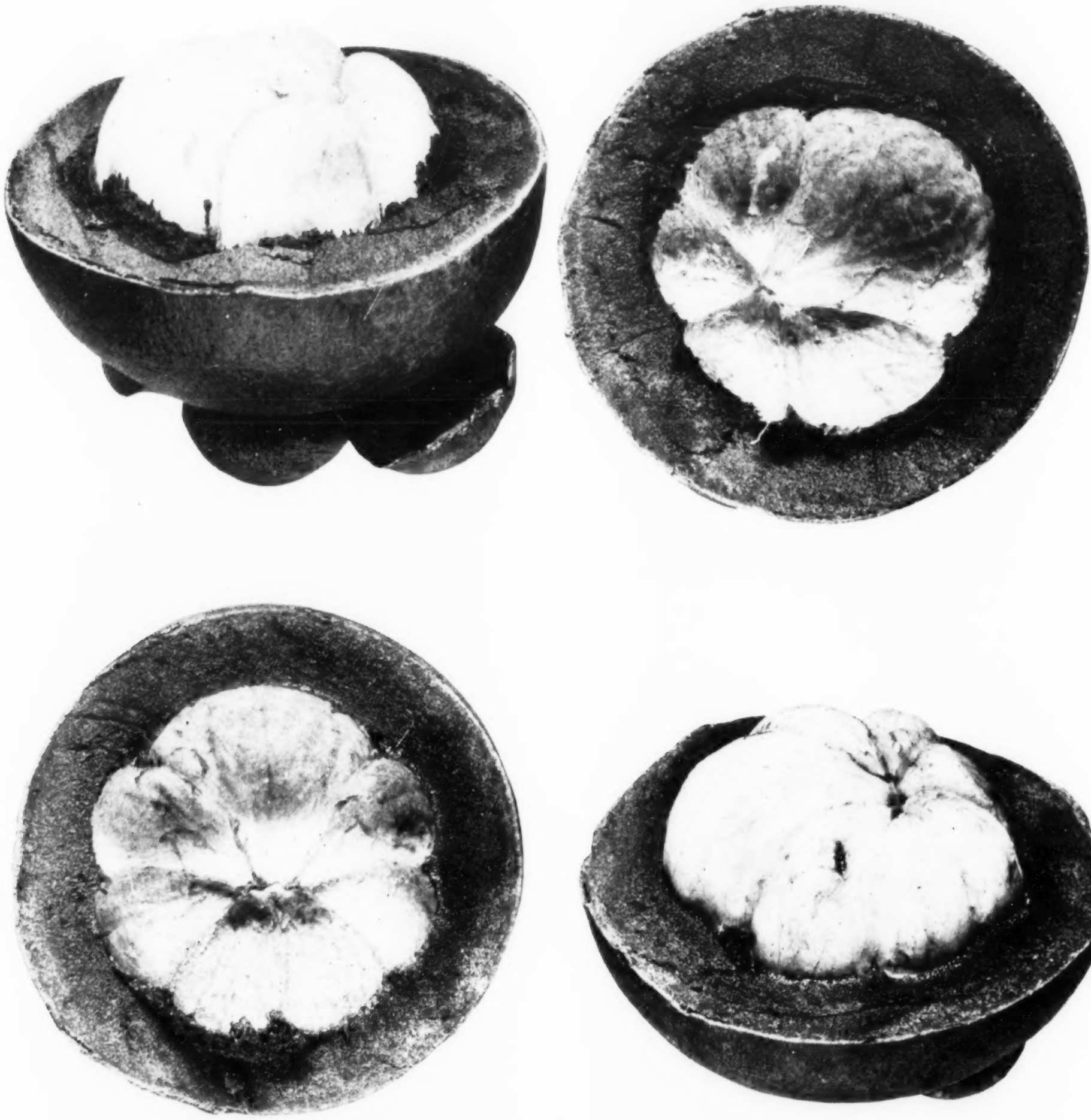
MANGOSTEEN UNIQUE

The mangosteen, however, though belonging to the category of a strictly tropical fruit, is so different from the majority of them as to deserve the special place accorded to it by all who have ever tasted its snowy white pulp. It outranks in delicacy, if not all other fruits in the world, certainly all others of the tropical zone,[1] and it is a joy to the eye as well as to the palate to feast on mangosteens.

This delicious fruit is about the size of a mandarin orange, round and slightly flattened at each end, with a smooth, thick rind, rich red-purple in color, with here and there a bright, hardened drop of the yellow juice which marks some injury to the rind when it was young. As these mangosteens are sold in the Dutch East Indies—heaped up on fruit baskets, or made into long, regular bunches with thin strips of braided bamboo,—they are as strikingly handsome as anything of the kind could well be, but it is only when the fruit is opened that its real beauty is seen. The rind is thick and tough, and to get at the pulp inside requires a circular cut with a sharp knife to lift the top half off like a cap, exposing the white segments, five, six

[1] This has been recognized by travelers in the East from the very earliest times. Jacobus Bontius, in his Hist. Nat. et Medic. Indiae Orientalis, VI, 28, 115 (pub. in 1631), wrote enthusiastically:

> Cedant Hesperii longe hinc, mala aurea, fructus,
> Ambrosiâ pascit Mangostan et nectare divos—
> Inter omnes Indiae fructus longe sapidissimus.



FRUITS OF THE MANGOSTEEN

One of the admirable qualities of the mangosteen is the beauty of its fruit. The thick, corky, outer shell, when cut, is of a delicate pink, rapidly deepening to crimson on exposure to the air. The segments of flesh inside are of an ivory tint. The heavy outer shell is a distinct commercial advantage, in protecting the fruit from bruises, during shipment. Photograph natural size. (Fig. 1.)

or seven in number, lying loose in the cup. The cut surface of the rind is of a most delicate pink color and is studded with small yellow points formed by the drops of exuding juice. As you lift out of this cup, one by one, the delicate segments, which are the size and shape of those of a mandarin orange, the light pink sides of the cup and the veins of white and yellow embedded in it are visible. The separate segments are between snow white and ivory in color and are covered with a delicate network of fibers, while the side of each segment where it presses against its neighbor is translucent and slightly tinged with pale green. As one poises the dainty bit of snowy fruit on his fork, and looks at the empty pink cup from which it has been taken, he hardly knows whether the delicate flavor or the beautiful coloring of the fruit pleases him the more, and he invariably stops to admire the rapidly deepening color of the cut

rind as it changes on exposure to the air from light pink to deep brown.

The texture of the mangosteen pulp much resembles that of a well-ripened plum, only it is so delicate that it melts in your mouth like a bit of ice cream. The flavor is quite indescribably delicious, and resembles nothing you know of; and yet reminds you, with a long after taste, of all sorts of creams and ices. There is nothing to mar the perfection of this fruit, unless it be that the juice from the rind forms an indelible stain on a white napkin. Even the seeds are partly or wholly lacking and when present, are so thin and small that they are really no trouble to get rid of. Where cheap and abundant, as in Java, one eats these fruits by the half peck and is never tired of them; they produce no feeling of satiety, such as the banana and the mango do, for there is little substance to the delicate pulp.

MAY BE DISSEMINATED

The tree which bears this fruit was once supposed to be able to live nowhere outside of the Malay region. It has in recent years, however, shown itself capable of acclimatization in many tropical regions remote from its original home, and it has even fruited in the unnatural conditions of an English greenhouse.

The mangosteen is no way related to the mango as it is sometimes thought to be from its name. Its foliage is of an even richer dark green than that of the orange, and its individual leaves are not wholly unlike those of the rubber plant, though, as a rule, smaller. The regular, rounded crown is strikingly characteristic and there are no more beautiful fruit trees in the tropics than the mangosteens. It has probably been in cultivation for centuries among the fruit-loving inhabitants of Java and Malacca, although the absence of any distinct varieties would seem to indicate the contrary. Perhaps in its wild state it was so nearly perfect that no attempts to improve it have ever been made.

Such a fruit seems almost to have been "born to blush unseen" for those parts of the world in which it grows are, as a rule, populated by half civilized races, who do not fully appreciate its extraordinary qualities. Had it been within easy reach of some great metropolis of white people, there would have been millions of dollars invested in its culture and thousands of acres planted with the beautiful trees.

The most delicious fruit in the tropics is surely worth the careful consideration of any government which owns territory suitable for its culture that is within easy reach by steamer of a big home market. The United States, since its acquisition of Porto Rico and the Canal Zone, is now in this position and the possibilities of the establishment of this fruit as an industry deserve to be thoroughly investigated. Trials of an extensive character should be carefully worked out, large numbers of plants ought to be started in different localities, and the intelligent attention of experts be given it. The establishment of the mangosteen as a minor industry in our tropical dependencies, should it prove a possibility, would be of very important commercial advantage to the inhabitants and would put within reach of our fruit-eating public, one of the greatest delicacies in the world.

SHIPPING QUALITIES GOOD

Although it is a very delicate fruit, its pulp is protected by an extremely hard, tough rind which makes it a tolerably good shipper. Quantities have been sent from Singapore to Ceylon and even to Shanghai and Japan, over eleven days by boat. The head steward of a Dutch vessel in the Malay Archipelago once informed me that he had carried mangosteen fruits for twenty-five days without their decaying, but that they must not be exposed to the sea air; and he was of the firm belief that they carried best in a dry, warm, close place, but decayed rapidly if given too much air or if put on ice. The decaying mangosteen hardens its rind, which is a distinct advantage, and makes continual sortings for fear of contamination unnecessary, as well as the immediate detection of a decayed fruit a very easy matter. According to Dr. I. N. Ridley,

MANGOSTEEN TREE IN LOMBOK, DUTCH EAST INDIES

The tree likes a large amount of water about its roots, but this water must not be stagnant. Most of the failures in cultivation appear to be due to overlooking this requirement. If it is properly attended to, the mangosteen will endure a considerable variety of soils and climates, and experiments made during the last generation leave no doubt as to the possibility of its acclimatization in various parts of the American tropics. Photograph by Fairchild. (Fig. 2.)

formerly superintendent of the Botanic Gardens of Singapore, the drops of yellow gamboge which sometimes form inside the fruit are not, as has been supposed, caused by a disease, but are the direct result of external bruises. A heavy storm may sometimes so knock the nearly mature fruits about that the majority will be worthless. Any very rough handling during the plucking may bring about the same result.

A more or less careful study of the question in Java, the Strait Settlements and Ceylon has convinced the writer that the acclimatization of the mangosteen on the island of Porto Rico, and in many other parts of tropical America, is a possibility and that the principal difficulties of its culture have probably arisen from an ignorance of the soil conditions demanded by the plant.

In Java, so far as the writer is aware, there are scarcely any commercial orchards of the mangosteen, every land owner having a few trees in his yard; in fact, the orchard method of cultivating fruits is, as a rule, little understood, or pays too poorly, to be followed in the tropics. Scattered trees through the native villages supply all the demands of the market.

EXPERIENCE AT SINGAPORE

In Singapore there are some small mangosteen orchards, that is, mango-

steens mixed with other fruits. One which is easily accessible lies on the well-known road to the Botanic Gardens, some 2 miles from Raffles Hotel. The land is low and wet and several drainage canals cut it up into large, square blocks. The soil is a clay and evidently saturated with moisture. About each tree is a circular bit of cultivated soil the rest being in grass, and scattered over the bare soil under the trees is a mulch of leaves and coconut husks. I do not know how old the orchard is, but it is presumably about 30 years of age. At this season, January, no sign of a bloom or fruit was to be seen. Dr. Ridley, then director of the Botanic Gardens in Singapore, remarked that though apparently in excellent condition this orchard was not productive. It was his belief that it needed pruning and his experience with a tree in Government House Gardens bears out his belief. He cut out the innermost branches from one of the lot of old mangosteen trees there, which had not borne well for years, and as a consequence it produced, the next year, an abundance of fruit.

His opinion is that the trees should be regularly pruned of all the small inner branches.

In Ceylon, where the species was introduced from the Straits Settlements about 1800, it is still a rare plant. This is the history of most fruits demanding certain special conditions in the tropics and, when one is told by those who should know that the natives of one part of Ceylon do not even know what the bread fruit is, although it forms a staple food plant in other sections of the same island, he ceases to wonder that even so remarkable a fruit as the mangosteen should be a rarity a century after its introduction.

The introduction of the mangosteen into Saigon about a century ago was more successfully done and it is interesting to note that the fruit was first brought from Penang by a noted Bishop, Father D'Adran. There are said to be at Lai Thiou, not far from the city of Saigon, what are probably the largest mangosteen orchards in the world, comprising 300 to 400 trees, and Dr. Haffner, formerly director of Agriculture of Cochin China, says that in the season the fruit from this orchard is sold for about two dollars gold a thousand, which price cannot be called high when compared with what they bring in Ceylon.

The popular idea that it is a difficult tree to cultivate has undoubtedly prevented many in Ceylon from trying it, and the secret of its successful cultivation seems even yet to be understood by only a few men in the island. To W. H. Wright, of Mirigama, the writer is indebted for full particulars of the culture of the mangosteen, with which Mr. Wright has been one of the most successful of all the men in Ceylon who have attempted to grow the plant.

SUCCESS IN CEYLON

His orchard consisted, at the time of my visit in 1902, of 23 trees and was then probably the largest in the colony. It was from 8 to 10 years old, having been planted out with young 2-year-old trees which were sent him as a present from the Malay Peninsula. The selection of a site for his orchard was a very happy one; a moist spot in his coconut plantation, a part of which had at one time been used as a rice field. The ground was so moist that open drains were cut through it to carry off the superfluous water and these are still kept in order. The soil of the squares on which the trees are growing is so moist and soft that, were it not for a layer of coconut husks, one's feet would sink in up to the ankle as he walks across them. The roots, under these circumstances, are bathed continually in fresh, not stagnant, moisture. Mr. Wright attributes his success in growing mangosteens to the fact that he has planted them on soil that never dries out but has, at a few feet from the surface, a continual supply of fresh moisture. The water in his well near by is six feet from the surface of the ground. H. L. Daniel, who has been for fifteen years trying to grow this fruit, and who, during that time, has planted over a hundred young trees, assures me that this is one of the secrets of the culture of this difficult fruit, and

gives Mr. Wright the credit for first finding it out.

Another important detail relates to the matter of transplanting the young seedlings. Mr. Daniel plants the seeds[2] in a small pot or in a coconut husk, and keeps them well watered and slightly shaded with a coarse matting of coconut leaves. He transplants from this small pot to a larger one when the roots have filled it; and in removing he cuts off the top root if the latter is exposed. For two years these young plants are kept in the pots and grow to a height of 2 to 2½ feet. It is useless to transplant them before they are at least 2 feet high, for the check given them, if too young, by the transplanting is so great that they refuse to grow, or, to use Mr. Daniel's expression, "they only croak."

SHADE IS NECESSARY

When transplanted, the plants are set in a hole 3 feet cube in size. Stiff soil is best but not absolutely necessary, as they will grow in light soil if the subsoil is a good paddy mud. From the first the young trees should be shaded with a matting of coconut leaves, which is suspended 2 feet or so above the top of the plant. This is to prevent the wilting and subsequent death of the two red, partly developed leaves, which first appear from the seed, and which must be kept alive if the plant is to make a rapid growth. If these precautions of potting, shading, and selection of soil are followed, trees should come into bearing seven years from seed, producing a small crop of a hundred fruits or so. The subsequent treatment of the mangosteen orchard seems to be very simple,—no pruning of any kind is commonly practiced, although it might be advisable to prune; and little cultivating is done. A mulching of coconut husks about the base of the tree to keep the surface soil continually moist, and the application of a small amount of earth from the poultry yard sprinkled about underneath the trees each year, are the only attentions given them. Whether or not artificial fertilizers could be employed with profitable effect is a question that has not been answered.

Favored with the conditions described, the trees on Mr. Wright's place have done remarkably well. They produce two crops of fruit a year: the first ripening in January, being from blooms produced in August, is a small one, not more than 100 fruits to each tree, while the second, from flowers produced in January or February, is a large one and matures in July and August. Mr. Wright estimates that each tree of his orchard produces from 600 to 800 fruits a year, counting both crops, and he has been selling these for six to nine rupees ($1.98 to $2.97) a hundred, making his gross receipts, figured on the lowest price, $11 to $15 per tree. The work of picking, packing and transporting to the railway station, although repeated every other day, is not expensive in a land where laborers earn only 12 to 16 cents a day. There can be no question that such an orchard pays well even in Ceylon, where the fruits are sold for from 2 to 3 cents apiece. What the profits would be if they were sold for such fancy prices as would be offered by the fruiterers of any big metropolis can be easily imagined.

AMERICAN POSSIBILITIES

There are many essential questions to be considered in connection with the introduction and establishment of the mangosteen industry in Porto Rico, Hawaii or Cuba, or in America generally.

The possibility of the plants living outside of their own home has been abundantly demonstrated. Trees are growing and have fruited well in Trinidad and Jamaica in the West Indies. Specimens have even been shipped from there to London. In the Territory of Hawaii, on the Islands of Kauai and

[2] The fruit is technically a berry, containing many ovules or seeds; but most of these in each fruit are aborted, for which reason it is difficult to get mature, well-developed seeds from good strains of the mangosteen. The pulp which is eaten is technically an aril, an extra coat that is developed in the same way as the original integuments are. The abortion of the ovule does not interfere with the growth of this aril.

ORIENTAL VENDOR OF MANGOSTEENS

The fruits are seen piled up in the basket on the left-hand side; among them are the fruits of the rambutan, *Nephelium lappaceum*, covered with long, fleshy protuberances while a small tray contains the fruits of the Doekoe (*Lansium domesticum*), an interesting fruit which is known in the Philippines as the "lanzon." The rambutan is closely related to the licher (*Litchi chinensis*), a fruit with which every traveler in South China is probably familiar. (Fig. 3.)

Maui, mangosteen trees fruit regularly, bearing good sized specimens of excellent flavor. Francis Gay, who planted the tree at Makaweli, Kauai, wrote that where the tree is growing the water is about 6 feet below the surface of the soil, that the tree is irrigated twice or three times a month, and that the rainfall of the region is 6 to 7 inches a year. This tree of Mr. Gay's is about 25 years old, fruited first when 10 years old and now bears only a few fruits per year; which latter very from 2½ to 3 inches in diameter. It stands about 15 feet above sea level in a spot well protected from the winds by windbreaks and is growing on a sandy, alluvial soil. Mr. Gay finds that only a small proportion of the young plants set out, live, the most of them dying the first year, but whether proper protection was given to the tender leaves of these young plants or not he does not state.

Dr. J. C. Willis, formerly director of the Botanic Gardens in Ceylon, assured me that trees grew well in the Gardens at Burliar in the Nilgiri Hills in the Madras Presidency of India. There are a number of trees in the Sulu archipelago of the Philippines, and even in islands much farther north, and fruit is shipped to Manila in the season. The mangosteen has even been brought into fruit under the grey

skies of England in the conservatory of the Duke of Northumberland, at Syon near Kew, as far back as 1854.

In Florida and California the mangosteen has been tried on numerous occasions, but without success. It is not likely that it will ever prove adaptable to the continental United States.

In Porto Rico it is not reported ever to have fruited—due merely to the fact, I believe, that it has not been adequately tried. In Cuba a number of trees have been planted, and some of them are flourishing; none of them has yet borne fruit. That they will under proper conditions stand a very high rainfall is evident from the climatic records of the country of their origin. Further, a tree 30 years old has long been bearing fruit at St. Aroment, Dominica, B. W. I., 400 feet above sea level, where the average annual rainfall is 105 inches; and at the Point Mulâtre estate in the same island are a dozen healthy trees, growing in rich valley soil under an average annual rainfall of 150 inches. No report is available on the fruiting of the latter trees.

FLOURISHES IN CANAL ZONE

The tree was introduced to the Canal Zone nine years ago, in a rather interesting way. Dr. W. W. Keene of Philadelphia, traveling in Malaya, ate the fruit, admired it and wrote to the Secretary of Agriculture in Washington asking whether it could not be introduced to the Canal Zone. The Secretary referred the matter to me, and I took it up with Col. Gorgas. After investigating the possibilities, the canal authorities finally decided to take up the introduction of new plants that promised to be of commercial value, and established an experimental garden. Among the first things I sent them were some mangosteens. They gave promise of being a complete success, but the experimental garden was unfortunately discontinued before any definite results had been realized. Lately the work has been taken up again, and I confidently expect to see the mangosteen fruiting in the Canal Zone.

There certainly can be no question, that the plant is amenable to acclimatization, and where the proper physical soil conditions are given it, which conditions seem to have been generally misunderstood, there is no reason why this plant should not be as common throughout the tropics of the Western Hemisphere as it is in the Malay region. Roxburgh's complaint that he could not get plants to grow anywhere in India has done much injury by discouraging attempts to cultivate it and loses force in the face of similar unjustified complaints formerly made in Ceylon where now there are successful orchards under cultivation.

RELATIVES OF THE MANGOSTEEN

There are several species of the big genus to which the mangosteen belongs that deserve attention as possible stocks upon which to graft the latter advantageously. The only record I have found of any attempts being made in the tropics to graft the mangosteen is that in Woodrow's Gardening in India, p. 173, where he states that he grafted one upon a related species of Garcinia (*G. indica*) at the request of a Revenue Commissioner at Rutnagberry, where 104 inches of rain fall in a year and the average temperature is 78. Unfortunately, nothing is said as to the success of this effort. Trials made at the Peradeniya Gardens, in Ceylon, to graft it upon another nearly related species, *Garcinia xanthochymus*, met with little success. This, however, does not signify that any unsurmountable difficulty would be encountered if the most careful methods of grafting which are in vogue in temperate regions were employed, or if even a sufficiently large number of trials were made.

The *Garcinia xanthochymus* is a rapid grower, abundant seed producer, and easy of cultivation, and might prove most valuable as a stock. If not, however, there are a couple of hundred other species which should be tested, some of them with edible fruits and others suited to dry hilly situations.

By using the old method of inarching, or "grafting by approach," G. W. Oliver of the U. S. Department of Agriculture was able to get altogether satisfactory results in working the mangosteen on twenty other species of the genus

Garcinia.[3] Of these, he says, "only a few can be recommended as promising stock plants. . . . The most promising species of Garcinia for use as stock plants for the mangosteen are *Garcinia tinctoria*, *G. morella* and *G. livingstonei*, in the order named, the last a native of Portuguese East Africa. The two first named are from the Malay Peninsula. . . . All the promising species ought to be tried whenever there is an opportunity. Some species of Garcinia lately found in the Philippine Islands would seem to be especially promising mangosteen stocks, especially those said to grow under widely varying conditions.

STOCKS EASILY GROWN

"None of the species of Garcinia used as stocks are difficult to raise from seeds, provided they are fresh. They are easiest to germinate when sown in soil composed largely of partially decomposed leaves mixed with a little loam and rough-grained sand. They should be potted as soon as the first leaves are well developed. All the Garcinias with the exception of *G. mangostana* have magnificent root systems, and they thrive under ordinary treatment in so far as soil watering and a considerable range of temperature are concerned."

Dr. Ridley, of Singapore, says the seashore mangosteen, *G. hombroniana*, is a species which he has long wished to cross with the true mangosteen. It has fruits with a delicate peach flavor and white flowers, and crosses between the two species might prove more rapid growers and better producers or make good stocks for the true mangosteen. In Cochin China there are at least ten species of *Garcinia*, three of which are edible, *G. cochin-chinensis*, *G. loureiri*, and *G. indica*, according to L. Pierre in his *La Flore Forestière de la Cochin Chine*. Specimens of several of these are now growing in the Botanic Gardens of Saigon and the late Dr. Haffner expressed a willingness to secure seeds for experimenters.

The whole subject of suitable stocks and improved methods of propagation of the mangosteen, deserves to be given a study in connection with its introduction into America. There are forty-two genera and 450 species belonging to the mangosteen's family (*Guttiferae*), many of which deserve investigation as mangosteen stocks. Mr. Oliver worked with two of these allied genera,—Calophyllum, which did not yield good unions, and *Platonia insignis*, which he says is "a very promising stock from one to three years after germination, and if it will grow under conditions suitable for the mangosteen, it may turn out to be the best stock of all those tried."

Especial effort should be, and to a certain extent is now being, made to find hardy stocks that will permit the propagation of the mangosteen in less strictly tropical regions than those to which it is now confined. It is possible that hybridization of some of these species would produce vigorous, resistant stocks that would be of great value. Here as everywhere among tropical fruits, the plant breeder faces opportunities of almost illimitable promise, and a field that has hardly been touched.

It is not likely that much is to be expected from direct hybridization of the mangosteen. It is already so far superior to its congeners, that hybrids could hardly fail to be worse, rather than better, than the parent, as far as quality is concerned. There is, however, ample room for selection, and isolation of the best strains, which may then be propagated under varietal names.

A thorough experimental study of the subject would doubtless show other possibilities that can not now be seen. At present, however, it is perfectly safe to say that there is no obstacle to the dissemination of this queen of tropical fruits, throughout the warmest parts of the American continent; and that if it can be grown on a commercial scale within easy shipping distance of Unites Stated markets, the connoisseurs of this country will have added to their menu a fruit which has been long acknowledged by many as the most delicate flavored fruit in the world.

[3] See Oliver, G. W., "The Seedling-Inarch and Nurse-Plant Methods of Propagation." U. S. Dept. of Agr., B. P. I., Bull. No. 202, Washington, D. C., 1911. Valuable details in regard to the growth of seedlings as well as propagation by grafting are given in this publication.

Physical Conformation of Cows and Milk Yield

J. Arthur Harris

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In a quotation from the Board of Agriculture on conformation of cows and milk yield which recently appeared in the Journal of Heredity, (p. 253, June, 1915) it is pointed out that so far as the studies of J. Reimers go, they show that there is no correlation between physical conformation and milk yield.

The results (at least as far as relationships close enough to have any practical significance for purposes of predicting yield from conformation are concerned) are quite what those who have an extensive first hand acquaintance with biometric work would have expected.

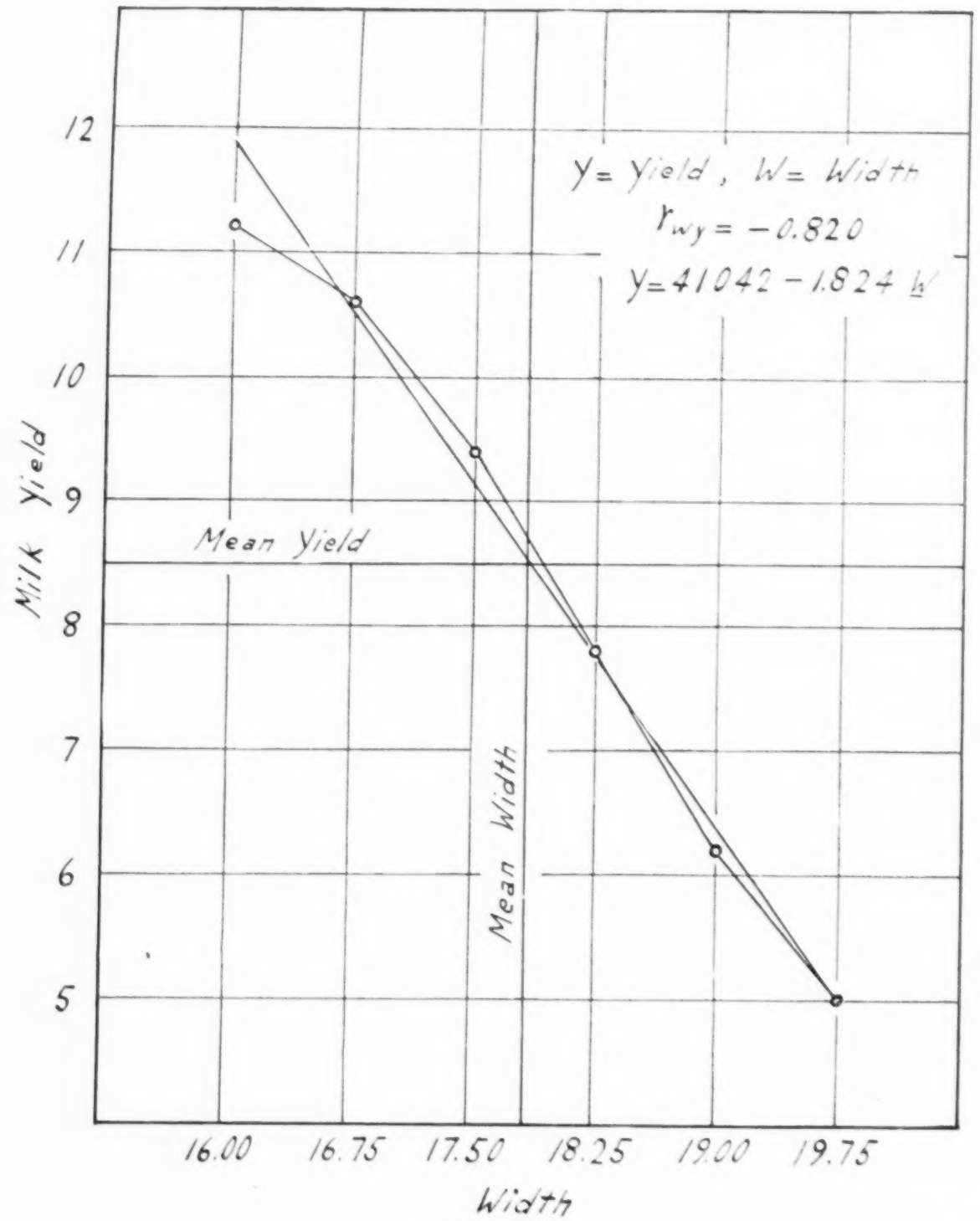
The purpose of this note is to call attention to and suggest an explanation for an anomalous series of data of this kind. G. Korreng has recently expressed the conviction (Jahrbuch für wissenschaftliche und praktische Tierzucht, vol. VII, pp. 132-142, 1912) that there is an intimate *negative* relationship between width of nether jaw, "Ganaschenweite," and milk yield —animals with the narrower jaws being the best milkers. In substantiation of his views he gives a series of 112 measurements and yields, which actually show a strong negative correlation between width and yield. The frequency of individuals having various widths and yields is shown in the accompanying table, which has been drawn up from his data.

In Figure 4, I have plotted out the mean yields for animals of different widths. They *decrease* with great regularity as width increases, as is shown by the straight line fitted to the data. Apparently, therefore, the data fully substantiate the contention that there is a relationship between conformation and milk yield so close as to be of practical value in selecting the best milkers.

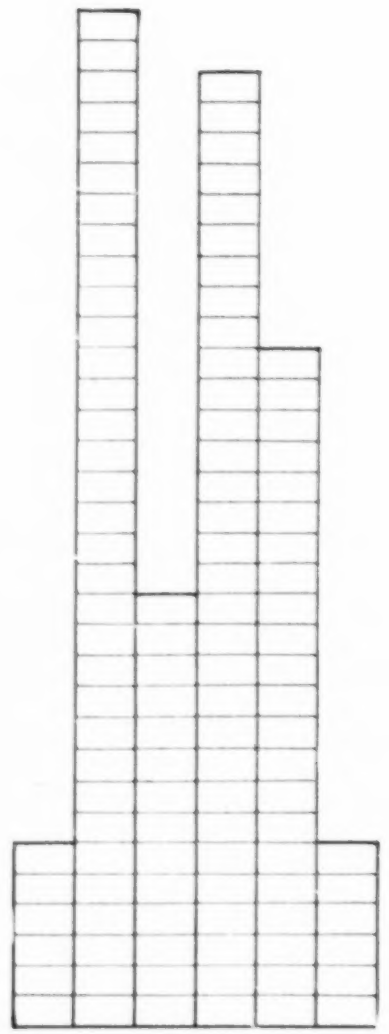
If, however, one carries the analyses of the records a step farther than Korreng has done, and examines the frequency distributions for the characters under consideration as shown in the totals of the table, and represented in Figures 5 and 6, he sees at once that both are distinctly bimodal. This is particularly conspicuous in the case of width. The two-humped condition is not so pronounced in the case of milk yield, but is nevertheless probably significant. These conditions suggest that Korreng's measurements were taken on a group of animals that are not racially homogeneous. A mixture of heavy beef cattle giving a low milk yield and light built dairy cattle would

MILK YIELD IN LITERS

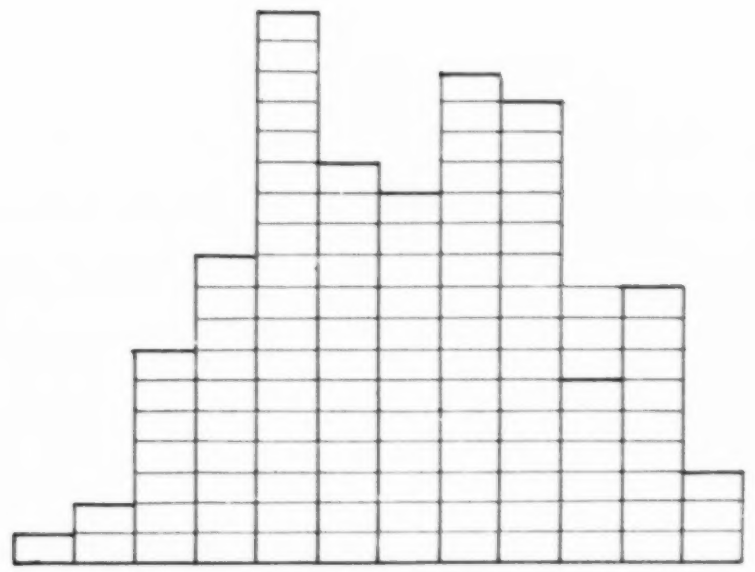
Width of Jaw in Centimeters	2.8 to 3.6	3.7 to 4.5	4.6 to 5.4	5.5 to 6.3	6.4 to 7.2	7.3 to 8.1	8.2 to 9.0	9.1 to 9.9	10.0 to 10.8	10.9 to 11.7	11.8 to 12.6	12.7 to 13.1	Totals
15.75–16.25	.....	.....	.....	.....	.....	.....	1	.....	1	1	3	.....	6
16.50–17.00	.....	.....	.....	.....	1	3	1	5	9	5	6	3	33
17.25–17.75	.....	.....	.....	.....	1	1	2	5	5	.....	.....	.....	14
18.00–18.50	.....	.....	.....	4	6	8	7	6	.....	.....	.....	.....	31
18.75–19.25	1	1	3	5	10	1	1	.....	.....	.....	.....	.....	22
19.50–20.00	.....	1	4	1	.....	.....	.....	.....	.....	.....	.....	.....	6
Totals....	1	2	7	10	18	13	12	16	15	6	9	3	112



(Fig. 4)



(Fig. 5)



(Fig. 6)

EXPOSING A FALLACY IN A CORRELATION

Measurements of the relation between width of lower jaw and milk yield of 122 cows satisfied the German professor G. Korreng that there was a negative correlation of .82 between them. This fact is shown in Fig. 4 above. If it were reliable, it is evident that by picking out cows with narrow jaws, we would get cows which were good milkers. When we go behind the returns, however, and examine the frequency distributions, as Mr. Harris has done in Figs. 5 and 6 above, we find that in each case where we expect to see a fairly smooth curve, we get a two-humped figure. This leads us to suspect that Korreng had two different kinds of cattle in the material he studied—for instance, a mixture of heavy beef cattle giving a low milk yield, and light dairy cattle. On a mixed group of this sort, it is evident that correlations are not of great value to the breeder. Nevertheless, the correlation found by Korreng is so high that it is of much interest, and should be tested by American dairymen.

theoretically give just such a result as this. Biometricians have frequently warned against the dangers of just such spurious correlations as this. Everyone knows that races of cattle differ in physical dimensions and in milking capacity.

What is really needed is a means of predicting yield from more readily measured characters *within a pure race*. Korreng's data are certainly not convincing in this regard.[1]

Nevertheless it must be admitted that here is a set of measurements which show a far more intimate relationship with milk yield than is generally found. The explanation suggested in this note may not be the correct one at all. Until such cases as the present are fully cleared up by those who have the necessary biological facilities the problem of the relationship between bodily conformation and milk yield cannot be considered finally solved.

[1] Korreng states explicitly that he used the greatest care in the selection of his animals. If they are really racially homogeneous the frequency distributions are very unusual. The only other explanations that I can suggest are that the bimodal condition is due to random sampling merely, or that personal equation played a part in the making of the measurements.

Milk Indications

For many years breeders have sought to find something in the appearance of a cow which would indicate whether or not she would yield much milk. Kronacher and Schmidt suggested that an animal with slender, delicate bones and horns would prove the best milker, and Laurer in 1910 presented measurements to prove this. He further attempted to show that there was a correlation in the growth of these parts: the finer the skeleton, the finer the horns, and conversely that large horns were always associated with a large skeleton. The numbers which he used were inadequate, so Dr. Max Müller and K. Narabe, of the Imperial Japanese University of Tohoku, have continued the investigation with 136 cows of different breeds, reporting their conclusions in the Landwirtschaftliche Jahrbuch, XLVI, 1, Berlin, 1914. They decide that the growth of bones and horns is closely related, and that the animals with small skeletons or delicate horns are the best milkers. Such "milk indications" have been reported many times in many countries during the last half century, and the breeder should take them all with a grain of salt, but it may prove of interest to some of the members of this association to test the theory in their own herds.

Crossing of Wheat Flowers Unprotected After Emasculation.

During the summer of 1911, 140 Turkey Red winter wheat flowers were emasculated. These flowers were on seven heads, each head containing twenty flowers. Two flowers, the first and second, were left in each spikelet, the upper flowers being removed by pinching off the rachilla above the second flower. Five spikelets were left on either side of the rachis, making a total of ten spikelets for each head. The spikelets left were the lower ones of the head, the upper spikelets being removed by cutting off the rachis above the tenth spikelet. The remaining flowers of the ten spikelets were emasculated in the usual way. The flowers were not artificially pollinated and the heads were not covered or protected in any way. At the end of the season the heads were harvested, the grains from each head being threshed out and counted. It was found that out of the total of 140 flowers emasculated, 112, or 80% had set seed.

It has been the writer's practice always to cover and protect the heads worked with after emasculation and after pollination to avoid the possibility of foreign pollen pollinating the stigma before the desired pollen was applied artificially and fertilization had resulted. This test was made for the purpose of determining whether there is any possibility of the emasculated flower becoming pollinated if left unprotected before pollination. Simultaneous with this trial another was made, in which a number of flowers were emasculated and were covered but were not pollinated. When these heads were harvested, it was found that less than 1% of the flowers had set seed, the small number of seeds produced apparently being the result of faulty emasculation, in which the stigmas became fertilized in removing the stamens from the flowers.

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SINGLE-GERM BEET SEED

Sugar Beet Is Being Made to Produce Single-germ Seeds Instead of Multiple-germ Seed Balls—Labor Thus Saved Will Mean Gain of Several Million Dollars Annually to Industry.

C. O. TOWNSEND

Bureau of Plant Industry, U. S. Department of Agriculture, Washington, D. C.

THE effort to produce a strain of sugar beets that will bear only separate seed germs, instead of the seedballs containing several germs, which ordinarily characterize the sugar beet, arose from a desire to reduce the cost of producing sugar beets and beet-sugar.

The term "seed ball," as applied to beet seeds, implies a combination of seeds into a mass having a more or less rounded appearance. Each germ arises from a single flower, and when they are in clusters of two or more, as is usually the case, a multiple-germ seed arises; whereas if the flower stands by itself on the stem, a single-germ seed results. If two or more single flowers stand very close together but do not arise from the same point as in the case of the flower clusters, each will produce a single-germ seed. Even if the flowers are so close together that the seeds slightly adhere in the process of development, they are easily separated and readily distinguished as single-germ seeds. It appears, therefore, that the arrangement and distribution of the flowers on the seed stalk determine whether the seeds are to be single-germ seeds or whether they are to be parts of multiple-seed balls. One can determine in practically all cases, even before the flower and buds are open, whether they will produce single-germ seeds or whether they will be parts of a multiple-seed ball.

More than 95 per cent. of the beet seed of commerce is composed of multiple-germ seed balls, the germs of which are so closely welded together by nature that they cannot by any known means be separated without injury to the germ. In other words, less than 5 per cent. of the seed balls of commercial beet seed consist of a single germ. The number of germs in the remaining 95 per cent. or more of seed balls varies from two to seven germs per ball. Hence the number of germs produced normally as single-germs, that is, not welded into combination with other germs, does not exceed 1 per cent. of the total number of germs produced by any commercial seed-producing plant that has come under the observation of the writer.

METHOD OF PROCEDURE

The fact that almost every beet seed plant that matures seed produces a few one-germ seeds shows that we did not create anything new by our work, despite a popular belief to the contrary. We simply took advantage of a tendency to produce single germs, and selected with a view to getting an increase in this tendency. Our goal is the production of a strain of sugar beets which will yield only one-germ seeds.

The principal value of such a strain lies in the economy of labor it would make possible. It is an established fact that the best results in beet growing are produced when each beet plant stands alone and 8 inches or more from every other beet plant. Remembering the construction or make-up of commercial beet seed, it is apparent that the only way to have each beet stand by itself, so long as multiple-germ seed balls are planted, is to pull out by hand all beets but one at regular intervals in row. This is called hand thinning and is the most expensive and laborious single operation in sugar beet growing, costing from $5 to $8 per acre, or

SINGLE-GERM AND MULTIPLE-GERM BEET SEEDS

The seedball at the left is made up of four seeds or germs welded together so closely that they cannot be separated without injury. It represents the common type of beet seed; when it is planted, several beets are likely to arise from the same point, and all but one of them will have to be pulled up by hand—a tedious and expensive operation. U. S. Department of Agriculture breeders therefore decided to make the sugar beet produce seeds with only one germ, such as is shown on the right, and their project has already reached such success that three-fourths of the seeds of their selected strain are now of this nature, whereas in ordinary beet strains not more than 5 per cent of the seeds are single-germ. (Fig. 7.)

approximately $3,000,000 annually for the entire beet acreage in the United States. Even if the multiple-seed balls are dropped in hills one seed ball in a hill, it is possible that in 99 per cent. of the hills there will be two or more plants in close proximity to each other. These plants, coming from the same seed ball, are necessarily so close together that they can not be reduced to one plant by any mechanical means that has yet been devised. Hence the only way to avoid this condition and to eliminate the expense and labor of thinning beets is to have all single-germ seeds.

BEGINNING OF THE WORK

The single-germ idea was suggested to Secretary Wilson in 1903 by Truman G. Palmer, Secretary of the Beet Sugar Manufacturers Association. Secretary Wilson approved the project and within twenty-four hours several hundred single-germ seeds had been selected, photographed and planted. Figure 7 shows a single-germ seed and a multiple-germ seed for comparison.

The first step in the solution of the problem was to grow roots from seed known to contain but a single germ. These seeds germinated freely and the plants grew vigorously, but since the beet does not usually produce seed the first year, it was necessary to store the roots and plant them out the second season for seed production. Hence the first crop of seed produced from single-germ seeds was in 1904. As was expected, there was a wide variation in the percentage of single-germ seeds on the various seed-producing plants in this experiment. In an effort to secure single-germ strains and to prevent crossing with plants of low potential with regard to singleness of germ, the most promising plants were covered with closely woven cloth bags. By promising plants is meant those that indicated by the number of single or isolated buds that the percentage of single germ seeds would be high. Further to insure the isolation of single flowers, all clusters of buds were carefully removed from some branches and the remaining buds were covered with paper bags, to prevent them from becoming pollinated with pollen from flower clusters. In many cases the pistils of the single flowers thus isolated were hand pollinated as soon as they were ready to receive the pollen. For this purpose pollen from flowers standing alone, that is, not in clusters, was used. Sometimes the pollen was taken from the plant bearing the flower to be pollinated, sometimes it was taken from other plants, thereby producing both close and cross fertilization. The work of hand pollinating was done under tents to guard further against unfavorable crossing.

Subsequent improvements have shown that in spite of all these precautions it was possible for unfavorable crosses to have been made by minute insects. However, our results indicate that we were in a measure successful in producing the pollination desired. Indeed, in our first generation of plants from seeds selected without any knowledge of their ancestry we found plants showing a single flower tendency and consequently a single-germ tendency to a marked degree. On the other hand, in some of the plants from single-germ seeds the flower clusters and consequent multiple seed ball tendency so predominated that the percentage of single-germ seeds was not appreciably greater than in plants grown from multiple-germ seeds. However, of the several hundred roots produced from single germ seeds over fifty produced upwards of 25 per cent. single-germ seeds.

RESULTS OF THE WORK

The fifty showing the highest number of single germs, as indicated in the bud stage, were selected, trimmed and isolated as thoroughly as possible in the manner indicated above. Having trimmed the best fifty plants, that is, removed all the flower clusters, leaving only the single flowers, it was obviously impossible for us to determine the percentage of single-germ seeds in this best fifty. The fifty-first plant selected was not trimmed and produced 25 per cent. single-germ seeds. The next best one had 21½ per cent., the next 21 per cent., and so on down to normal. A commercial beet seed field of 17 acres in the same locality was carefully searched and the plant having the highest number of single-germ seeds showed 4.77 per cent. by actual count, the average for the best ten in the commercial field being 2.7 per cent.

In the second generation the number of single germ seeds was upwards of 50 per cent. on the best plant and in the third generation it was about 75 per cent. Therefore, continuing along these lines, it is fair to assume that it is only a matter of time when a plant bearing only single-germ seeds will be produced.

To sum up the work, it is apparent that commercial beet plants normally produce a few single-germ seeds. Our problem was, by selection, to increase the proportion of single-germ seeds from less than 5% to 100. Our selected plants are now producing about 75% of single-germ seeds, and individual plants in a few cases show a somewhat higher percentage than this. The work and progress of single-germ beet seed

production is based upon the fact that certain beet plants possess the ability to so develop the seed stems that the buds and flowers are separated from each other in the process of growth. This tendency to separate the flowers and thereby to produce single-germ seeds seems to be transmissible from parent to offspring; whether or not this will become a fixed character time only can tell. The indications are that this character will become fixed and that a reasonable amount of care on the part of the beet seed growers will make the production of single-germ beet seed commercially practicable.

Success with Sugar Cane

Sugar cane breeding has been in process at the Louisiana Agricultural Experiment Station for nearly twenty years; the varieties D74 and D75, which make up about half the acreage of the State, were both put out by the station. Rice, cotton and tomatoes are also handled.

Sugar Cane Breeding

By selecting seedling sugar canes, the Porto Rico Agricultural Experiment Station has secured varieties that are notably more resistant to disease, give a larger tonnage and have a higher percentage of sucrose. Improvement of the pine-apple by seedlings is also under way. Those who have eaten the pine-apple will object that they know it has no seeds; but if cross pollinated, seeds are frequently developed. Conditions are the same with the banana, by the seeds of which, secured through crossing native varieties with fiber-producing species from the Philippines, the station is attempting to produce better races.

Controlled Cotton Breeding

Although a good deal of cotton breeding has been done in the United States, little of it has been so controlled as to afford reliable information about the manner of inheritance of characters of the cotton plant. The Mississippi Agricultural Experiment Station has taken up this study, using American Upland, Sea Island and Egyptian varieties in crosses, followed by isolation and self-fertilization. One of the interesting points involved is the extent to which Mendel's Law is obeyed in inter-specific as well as inter-varietal crosses, the claim being made by De Vries and others that where distinct species or genera are concerned, Mendelism rarely is demonstrable. The station also wants to produce cotton that, by ripening earlier, will avoid ravages of the boll weevil; this leads to a careful investigation of the numerous factors which combine to make the quality loosely termed "earliness," while the possible correlation between earliness and production of greater lengths of fiber is also being studied.

Would Utilize Bud Variation

The West Virginia Agricultural Experiment Station is endeavoring to take advantage of bud variation in sweet potatoes and strawberries, to improve the strains grown in that State.

OFFSPRING OF THE INSANE

Preliminary Report of Study of Ten Families Shows That Taint Ordinarily Does Not Manifest Itself in Filial Generation—Imperfection of Dominance Suggested by the Results.[1]

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ANY study of the ancestors of the insane brings to light cases, not only of insanity, strictly so called, but also of various kinds and degrees of slighter neuropathic affection, some of which are not readily and sharply to be distinguished from the normal state. The material of such a study reveals, for the most part, not the manner and frequency with which insanity is transmitted from parent to offspring, but rather the frequency with which slightly neuropathic or even normal parents may, in some cases, beget insane offspring.

It may be that if satisfactory material could be made available for a study of a sufficiently large number of generations of ancestors the inheritance could in every instance be traced to cases of the same kind and gravity of neuropathic disorder as that which is taken as the starting point of the investigation and which all agree upon as being properly designated by the term insanity.

But the fact is that such material is not made available by even most thorough investigations and that the information secured concerning even the more immediate ancestors is apt to be indefinite and incomplete.

These considerations have led us to undertake the collection of material for a study of the offspring, in place of the ancestors, of the insane. The object of this report is to describe the plan of our study and some of the material that has been collected since its inauguration a little over a year ago.

The first feature of our plan is to select cases of patients who have offspring old enough to make possible a fairly definite judgment as to degree of intellectual development at its height and as to the presence or absence of notable nervous or mental anomalies.

No matter what theory of the mechanism of heredity may be preferred, it is now generally conceded that, in order to be complete, a consideration of the inheritance of any trait must take into account the facts presented by not one but both ancestral branches. In the present connection, it is hardly to be doubted that whether the offspring of an insane subject will or will not show evidences of neuropathic inheritance will depend not only upon the inheritable nature of the one parent's insanity but also on the nature of the mental inheritance from the other parent.

Accordingly, the second feature of our plan is to collect information concerning the consorts of the patients, the consort's parents and sibships, and other relatives if necessary or advisable.

The third feature of our plan is to make, as far as possible, direct observations of the offspring. The material is to consist not of ready judgments as to the normality or abnormality of subjects but of biographical facts and records of observation which might serve as basis for such judgments and which, if there be mental derangement, would make possible a comparison of its nature with that of the source of its inheritance.

The work is necessarily slow; the investigations of some families have been halted for one reason or another at

[1] Submitted to the annual meeting of the American Genetic Association, Berkeley, California, August 2-7, 1915.

various stages of their progress, and those of some others have had to be definitely abandoned.

Thus far we have completed the investigations, in accordance with the plan here outlined, of ten families, including a total of over 400 individuals.

The total number of direct offspring of the insane represented in this material is sixty-nine, and of these forty-one lived to an adult age. They are the offspring of five patients with dementia praecox, three patients with psychoses not definitely diagnosed but classified as allied to dementia praecox, one patient with paranoic condition, and one patient with epileptic dementia.

We hope, when our work is finished, to publish a full description of our material; for the present, we would submit the following general account of our findings:

In four out of the ten families that have been investigated all the offspring who survived to an adult age, sixteen in total number, were entirely normal so far as it was possible for us to judge. This part of our material, then, seems to support the view, already expressed in a previous study,[2] that the forms of insanity here dealt with behave in heredity as Mendelian recessives in respect of failing to appear in the first filial generation of hybrids.

In four other families some or all of the offspring showed slight or transient neuropathic symptoms interfering but little, if at all, with living at large and pursuit of ordinary occupations. This suggests, as a possible explanation, imperfection of dominance, for which some evidence in material of neuropathic inheritance has also been adduced[3]. The total number of offspring in these four families, which survived to an adult age, was seventeen; and of these eleven showed slight neuropathic symptoms, as mentioned above, the remaining six being entirely free from even such symptoms.

Of the offspring in the remaining two families, of whom nine survived to an adult age, two were insane and committed to institutions; one was insane a short time and committed suicide—the physician who was called in had suggested that she be sent to an institution; two showed slight neuropathic symptoms; and the remaining four seemed entirely normal.

The facts concerning the consorts of the patients and the consorts' parents, sibs, and other relatives, as we have them on record, contain much that would help to explain the contrasts presented by the fraternities of the ten families; we hope that some parts of the material may serve also as basis for the formulation of definitions of inheritable units in human mental constitution, for we do not believe that traits that can be tolerably well defined without reference to facts of their hereditary transmission are necessarily, or even probably, true biological entities.

[2] Rosanoff and Orr. *A Study of Heredity in Insanity in the Light of the Mendelian Theory.* Amer. Journ. of Ins., Vol. 68, Oct. 1911; also Bulletin No. 5, Eugenics Record Office, Cold Spring Harbor, N. Y.

[3] Rosanoff. *Dissimilar Heredity in Mental Disease.* Amer. Journal of Insanity, Vol. 70, July, 1913.

Bud Selection in Apples

At the Missouri Agricultural Experiment Station, bud selection is the subject of research in apples. Three crops have now been harvested from trees, part of which were grown from scions selected from high producing parents and part from parents of low producing habits. The difference in yield has not been large enough to be significant. "There was practically as much variation in yield of fruit and in size and color of fruit between trees from the same parent as there was between trees of different parentage."

APPLES OF THE CORDILLERAS

A Notable Case of Plant Migration—Fruit Now Grows Wild in Profusion—Introduced by Spaniards and Immediately Took Possession of the Country—Account of Early Explorer

WALTER FISCHER, *Washington, D. C.*

THERE are few of us to whom some one or all of the great movements or migrations among the myriads of our earth's inhabitants are not of more than passing interest, be they among plants or animals or among the races of man himself. In history the period of the great migrations is perhaps the most fascinating of all to the average reader. Census figures, showing the rapid growth and shifting of populations, aside from their special value and interest to the sociologist and business man, are of general interest to every one, as phenomena of nature. Hunters, stockmen and fishermen notice the movements and migrations of the flocks, herds and schools in which they are particularly interested, to say nothing of the appearance and disappearance of the flora and fauna upon which their charges and interests are dependent. The man who tills the soil, whatever his specialty may be, is undoubtedly most vitally affected by invasions and inroads of plants and animals, while for the nature student the opportunities for study and observation of such phenomena are extraordinarily rich.

The migrations of man lead all others in importance, not only on account of their magnitude in themselves but because, since his appearance in the field, practically all changes in the position and number of different species of plants and animals have been due directly or indirectly to his activities. Some of the changes going on in the fauna of a country are: the reduction, extermination and transfer of native species; the introduction of domestic animals and household pests; and the introduction and spread of insects and other forms of life that prey on animals and plants newly introduced or that chance to find unusual opportunities for development in a new environment. In the flora the changes that take place are similar: numerous species and individuals of cereals, vegetables, fruits and ornamental plants are introduced, to say nothing of the multitudinous plant pests, such as the weeds and fungous parasites which accompany them; while corresponding transformations take place in the native flora to make room for the new comers. Nature becomes cosmopolitan wherever man has left his footprint.

ADAPTATION TO NEW ENVIRONMENTS

The ready adaptation of certain species of plants and animals to their new environment, where they often thrive and multiply in a manner never dreamed of in their former home, is usually the object of no small wonderment. It is one of the most natural things in the world, however, and merely proves that the best conditions for their development are more or less duplicated throughout the world, often even more favorable in a new locality than in their old home, and that their distribution has been largely due to causes other than those that were responsible for their original evolution. In plant life we have been led to believe by our observations that herbaceous plants, and most commonly the annual weeds found near habitations or accompanying the sown crops, have been the most successful invaders and colonizers, and this on the whole is undoubtedly true. These very weeds, however, in most cases and in a certain sense, are domesticated plants largely dependent upon artificial surroundings to which, like the more useful plants, they have

WILD ARGENTINE APPLE TREE

In some parts of Argentina and Chile, the apple has found particularly congenial surroundings, and appears to have escaped from cultivation within a few years after the Spaniards introduced it. With incredible rapidity it established itself through the river valleys, and now gives every appearance of being absolutely at home. Photograph in the valley of the Alumine River, Territory of Neuquen, Argentine Republic. (Fig. 8.)

conformed themselves and in which, in spite of our efforts at extermination, they find the most favorable conditions for growth. Shrubs and trees, although just as successfully transferred to new countries by the help of man, more rarely are invaders of their own accord or become aggressive in their new surroundings. By their very nature and size, there is little chance for them to escape destruction under the artificial conditions where herbaceous plants flourish, and, as in the case of those herbaceous plants which have actually been able to escape and compete successfully with the indigenous species in their own habitat, those that survive are few in number and exceptional. It is of such an exceptional case that this article treats.

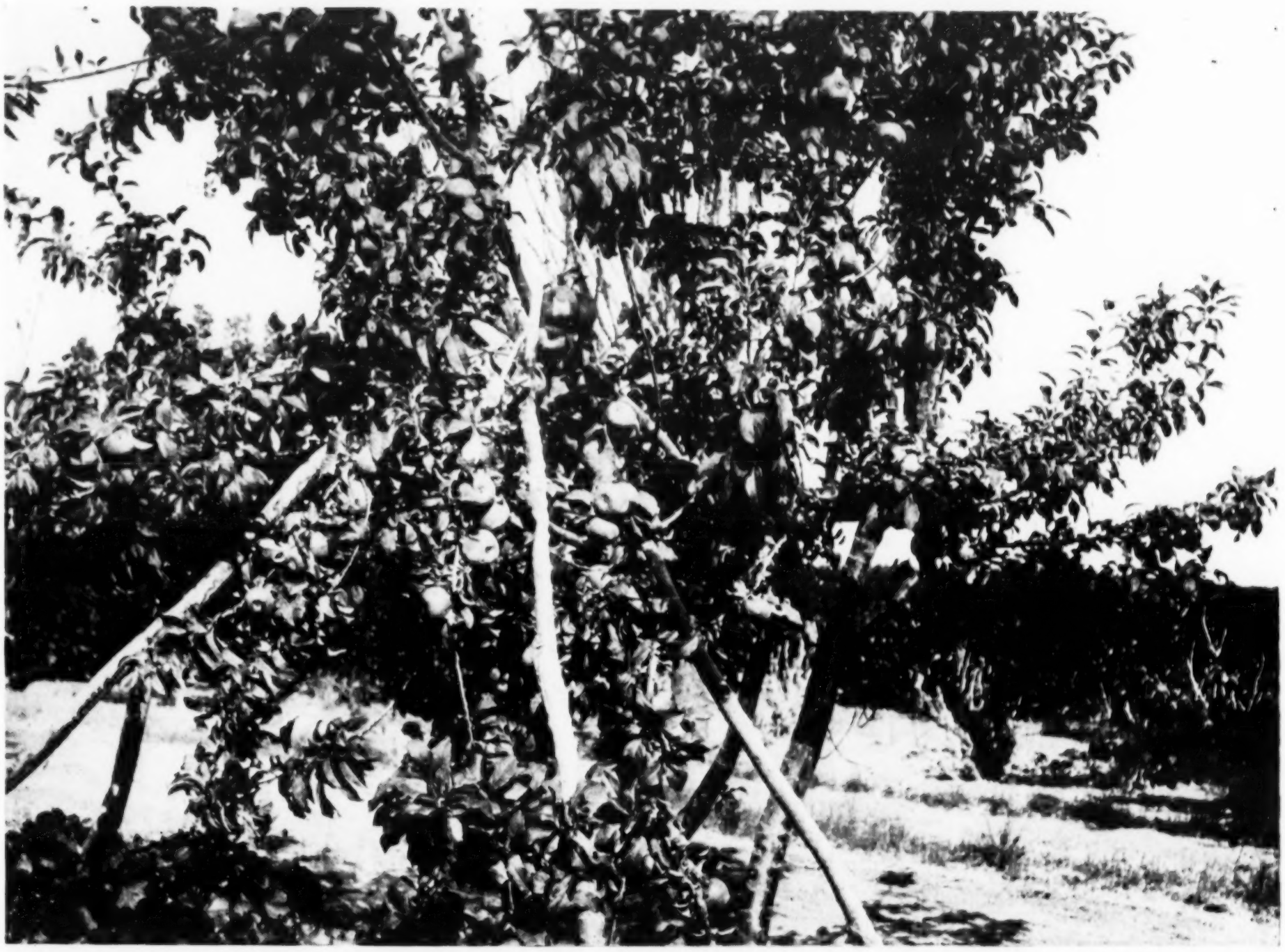
The apple is, generally speaking, the best known and most widely planted of all trees. The first and most natural inference, at least as far as it relates to any of the newly discovered continents, is that it was introduced from elsewhere, and that inference is correct. Its exact place of origin is obscure but that it came from the old world is certified by historical records of its use and cultivation in very ancient times and more especially by the charred remains of apples that have been found in the Swiss lake dwellings, which flourished probably 2000-4000 B. C. It is now grown in all countries of the temperate zone where it usually escapes from cultivation to a limited extent. It furnishes a good example of what was said above about plants or animals often doing better in a new locality than in

their original home. It is generally recognized, for instance, that, under cultivation at least, it has found more favorable conditions for its development in North America than in Europe or Asia from whence it originally came, although it has never escaped to a large extent nor gone far from the orchard or fence corner. De Candolle speaks of the apple as "appearing most indigenous" in the region between Trebizond and Ghilan in Persia. It is doubtful, however, whether it appears more indigenous there than it does in the southern Cordilleras of Chile and Argentina. In this case the question as to whether it is indigenous or not could hardly arise, and its presence there constitutes one of the most remarkable phenomena in the great movements of plants on this earth.

THE CORDILLERAN APPLE COUNTRY

Roughly speaking, the wild apple country of Chile and Argentina is cut in half by the 40th degree of latitude south, having a total extension of about 200 miles north and south and lying on both sides of the continental divide. In Chile it extends to the Pacific coast and in Argentina to the eastern limit of tree growth. The Argentine side without doubt, on account of the more definite landmarks in the history of its settlement, offers the more interesting and profitable field for study. The heart of this apple country, a region of many mountain lakes, snow-capped peaks, small rivers and valleys, vying in scenic beauty with the Alps and the Yosemite, lies just north of the beautiful lake Nahuel Huapi, between the river Limay and the divide, and drained for the most part by the Colloncura, a branch of the Limay, and its extension the Alumine. The general level above the sea of the valleys is about 3,000 feet; there are no extremes of temperature, the minimum, so far observed, being 7° F. The region lies within the sphere of the western trade winds of the southern hemisphere which bathe the Chilean slopes of the Andes in the same latitude with from 100 to 120 inches of rain annually, but which lose their moisture on contact with the cold Andean peaks and sweep down on the eastern side with great velocity and drying powers. One small district still has, however, the greatest rainfall of any in the Argentine Republic, something like 75 inches at San Martin de los Andes not so very far from the Chilean boundry; but it varies greatly, amounting to only 32 inches at Junin de los Andes, for instance, not more than 20 miles distant, and decreasing to about 15 inches at the beginning of the Patagonian tablelands in the interior. About three-fourths of this precipitation occurs during the winter months, making the seasons similar to those of the Pacific Coast and the Mediterranean. The indigenous vegetation varies with the rainfall and according to the amount of protection found against the cold drying winds from dense rain forests, similar to those of Washington and Vancouver, with almost impenetrable undergrowth, and more open coniferous forests of Araucaria, to mountain meadows and dry grass-lands bordered and broken by forests or clumps of trees and shrubs. In the moister regions, strawberries, currants and potatoes are native, while white and red clover, timothy and other grasses have escaped from cultivation. The region is quite thickly dotted with ranches and settlements at the present time, although not yet accessible by railroad.

The apple is especially abundant in the valleys of the Alumine and its continuation the Colloncura, their numerous tributaries and the lakes which drain into them. It is found along the borders of forests, streams and lakes and reaches its greatest development in the regions of moderate rainfall, where it is found singly or in groups wherever there is some protection from the cold dry winds, in sheltered valleys and ravines, and especially near streams and springs where the roots can find water. It is *Pyrus malus* L., the apple that is planted throughout the world; all plants are seedlings, of course, and the fruit, as might be expected, is of all sizes, forms, shades, flavors and degrees of sweetness and acidity. Where the trees are much exposed they seldom bear on account of the hard winds prevalent at blossoming time. But on



GROWING UNDER CULTIVATION

A wild apple of the Cordilleras, domesticated in the Rio Negro valley. When given some care, these trees bear large crops of fruit, and although the quality is very diverse, as is usual with seedlings, much of it is good. (Fig. 9.)

many branches the apples are gathered to the extent of hundreds of bushels and usually made into cider, or they are eaten by the numerous herds of cattle that range the mountains. The woolly aphis has commenced its depredations among the trees and is fast penetrating to the most remote.

HISTORICAL RECORDS

The generally accepted explanation of the apple in this region is that it was introduced by the early Jesuit missionaries. The oldest record found is that in the diary of D. Basilio Villarino, pilot of the royal armada, who had been ordered to lead an expedition up the Rio Negro from the sea for the purpose of reaching Valdivia on the Pacific coast by an overland route. His voyage lasted 8 months, from the twenty-eighth day of September 1782 to the twenty-fifth day of May, 1783, only three weeks of which were needed for the return. Hardly a month out, October 26, and not yet far from the Atlantic coast, he speaks of the *Tierra de las Manzanas* (apple land), about which he had heard through the Indians that were accustomed to descend to the Pampas in search of cattle and horses. By January 23 he had reached the juncture of the rivers Neuquen and Limay, and ascending the latter, about three weeks later, his advance party brought in branches from apple trees found on the banks of a small stream flowing into the Limay from the west. Unfortunately, for the purpose of his expedition, Villarino did not continue to follow the Limay to its source, but went up the Colloncura which was more easy of navigation; he then probably proceeded up the Chimehuin, a river flowing into the Colloncura from the west just a little north of the 40th parallel, to the neighborhood of lake Huechulaufquen. Almost daily,

while navigating up these two rivers, his scouting parties brought in apples that they had got by barter from the Indians. He mentions apples weighing as high as 17 ounces and remarks about what good apple gatherers the Indians were as they never left "even one" on the trees found by his men. The Indians made *chicha* from them, evidently a kind of cider, and *orejones*, dried apples. The following is a literal translation of the entry in Villarino's diary for the twenty-ninth of April, 1783, probably written not very far from the present town of Junin de los Andes:

"It dawned cloudy, with the wind W. strong and very cold. At 8 it commenced to clear, and I set out to observe the latitude of the mouth of the River Huechum-Huechuen; I returned at 4 in the afternoon. Today the *Chinas* (Indian women) led in fifty to sixty packs with apples. They set out at 8 o'clock and returned at 2 in the afternoon; others who set out yesterday noon, returned today at 4 o'clock in the afternoon, and these say they went to Huechum-Huechuen, because the apples from there are much better than those from other parts. I could very easily and at small cost have loaded the shallops with this fruit, but the apples came all bruised and battered, not only because they pick them up from the ground when they are already bruised from the fall, but because of striking and rubbing against one another in the packs, through the motion and trotting of the horses, so that few sound ones remain that can be saved. I put on board more than 8,000 and inspecting them this afternoon found them nearly all rotted: so that I think I shall inspect them tomorrow, and of the pieces which I find sound make *orejones*. Many are the varieties of the apples on hand, and in flavor the apples of Galicia, my native land, surely do not excel them. This evening they brought me twelve pippins, which they were able to select from the less bruised; it is surely a pleasure to look at them, and apples of this kind are called *repiñaldos reales* in my country. In none of all the places ever traversed by me, were there such good apples and such a variety and abundance as here. . . ."

On the following fourth of May, discouraged by sickness among his men, by the hostility of the Indians to his plans and by the approaching snows of the season, Villarino started out on his return voyage.

And now as to the date of the first possible introduction of the apple into the region east of the Andes, from which its rapid and remarkable spread might be traced. The Spaniards first attempted to conquer and settle southern Chile between the years 1541 and 1551, those being the dates of the founding of Santiago and Valdivia on about the 33d and 40th parallels of latitude respectively. In 1553 Francisco de Villagran, a captain of Valdivia, crossed the Andes in 39° latitude as far as a large river (perhaps the Alumine) and in the same year most of the settlements in Chile were destroyed by the Araucanians, followed by nearly 100 years of almost incessant warfare until the peace of Quillen in 1640 (which was soon followed by other wars, however), allowed the Indians undisputed sway over all the territory south of the Bio Bio, or 37° and 38° latitude. The first settlement east of the Andes was that of the Jesuit mission founded by Nicolas Mascardi in latitude 41 on the shores of lake Nahuel Huapi in 1670, but destroyed in 1717. Unsuccessful attempts at its restoration were made in 1764 and, outside of a few other unimportant expeditions which could have left no impression upon the region, and the notable expedition of Villarino in 1783, the country was left undisturbed by white men until settled during the latter half of the nineteenth century by the gradual infiltration of settlers from Chile and still later from Argentina.

Taking into account the unsettled conditions on the Chilean side of the southern Andes or Cordilleras and that the eastern side had hardly been touched by white men, and above all that the influence of the Jesuits was never great among the Araucanians and Transandine tribes, the wide distribution of the apple in a region so remote at such an early date as 1783, is truly remarkable. It proves that it spread very rapidly either from the solitary mission post on Nahuel Huapi or through the passes in the Andes from Chile, or both, by natural means such as animals or semi-savage Indians and water currents, and that it found exceptionally congenial conditions for its development. A closer study and comparison of this region with some of those parts of the old world where the apple appears indigenous might throw additional light on its origin.

FROG'S HAIR

African Batrachian Possesses Hair-like Appendages Whose Origin Is Shrouded in Mystery—Probably Secondary Sexual Character

"FROG'S HAIR" has long been an ingredient of popular metaphor, and considered as mythical as the equally famous "hen's teeth." When, therefore, G. A. Boulenger described in 1900 two frogs from the German Congo which had a partial covering of what looked very much like hair, his description did not fail to awaken a deal of interest, among those who came across it.

Were the mammals to lose one of their distinguishing characteristics, through its extension to the frogs? Boulenger admitted that he did not know much about it, but said that these "villose dermal papillae" were not a nuptial attribute of the males, but were rather more strongly developed in the female than the male. He suspected them of being a seasonal appendage.

In 1902 he published another short paper on the subject describing seven more specimens of the same species (*Astylosternus robustus* Blgr.). In this case the females showed no trace of the appendages, while in the two males they were fully developed. The specimens were evidently obtained during the breeding season.

Meantime Dr. H. Gadow had made a microscopical examination of the hair-like structures, and reported that he was unable to find any nerves in them, although he made out some insignificant blood vessels and lymph spaces. He concluded that these appendages could not be considered a sensory apparatus, and agreed with Boulenger that their function was a mystery.

There the case remained until Willy Kükenthal, working in the Museum of Comparative Zoology at Harvard College, reviewed it[1] by the study of eleven specimens from Kribe, Kamerun. He established that the hair-like appendages were present only in the males, and altogether wanting in the females. This confirms Boulenger's second report; evidently his first one was an error.

It was further found "that these appendages do not attain the same degree of development in all male individuals, and that even in full grown males there are very conspicuous differences in this regard."

He believes, although data are few, that the hair-like covering is most highly developed during the breeding season, and that it is to be considered a secondary sexual characteristic.

"The fact that a younger (smaller) male, contained in the same jar with the two adult males possessing fully developed appendages—and therefore apparently captured at the same time with these—showed this hairy coat in its beginnings, points to the conclusion that the appendages are fully developed only on adult animals and probably, as I have already suggested, at the time of mating.

"Now arises the question, from what do these organs originate? The reply requires a careful investigation of the female. It is quite surprising, that none of the former investigators has observed the fact, that the females have, on exactly the same parts of the body that on the males bear these appendages, small but quite distinct tubercles, which have the same diameter as the bases of the appendages in the males. Their distribution over exactly the same areas of the surface shows clearly that they are homologous with the appendages of the male.

"Moreover, if we carefully study the surface of the skin, we find that both males and females show similar tubercles scattered over the whole back, and that they are more closely crowded in the region of the angle of the jaws. In some areas of the surface of the males

[1]Bull. Mus. Comp. Zool. at Harvard College, Vol. LIII, No. 9, pp. 371-376, 2 figs., 5 plates.

A "HAIRY" FROG FROM THE GERMAN CONGO

Owing to the extraordinary development of tubercles on the skin, this species seems to have hair. The hair-like appendages appear to be a peculiarity of the males only, and to be most highly developed among adults, and at the breeding season. They apparently serve as sensory organs, and are to be considered a secondary sexual characteristic, but their exact purpose is a matter on which one can hardly even guess with profit. From Kükenthal. (Fig. 10.)

we may even observe the transition of these tubercles into villose appendages. From these comparisons we must therefore draw the conclusion that these appendages have arisen from tubercles of the skin, such as we find scattered over the skin of this species in other regions of the body and such as are recorded from other Ranidae.

"These hair-like appendages are therefore to be considered as highly developed tubercles of the skin."

Mr. Kükenthal then had recourse to the microscope, and arrived at quite different conclusions from those of Herr Gadow. In particular, he found that the organs contain both nerves and nerve-terminations, "and that therefore they do serve as sensory organs."

As to the exact function of these peculiar appendages, one can only guess. Evolutionists will certainly hope for observations on living specimens, in order that some light may be thrown on the cause which called forth this hair-like covering, so different from anything found on other frogs.

NEW PUBLICATIONS

REPORT OF THE COMMISSION to investigate the extent of feeblemindedness, epilepsy and insanity and other conditions of mental defectiveness in Michigan. Lansing, Mich., Wynkoop, Hallenbeck Crawford Co., State Printers, 1915.

In 1913 the Michigan Legislature appointed a commission to make a survey of the State and report on the amount of mental defect in the population. The 175 page report of this commission makes a startling document, although it is not to be supposed that conditions are worse in Michigan than in most other states of the Union. It is found that there are 7,703 insane in institutions, of whom probably two-thirds owe their insanity to heredity, and that the various county infirmaries and reform schools are crowded with people, many of whom are feebleminded. Many of these are set at liberty each year, to reproduce their kind, and many insane persons are similarly uncontrolled. The State laws prohibiting marriage to these classes are not enforced, and the Michigan sterilization law is practically a dead letter. A general reorganization of the method of caring for defectives in the State is necessary; but as the commission points out, the first, cheapest and most effective thing to do is to segregate at least the female defectives for life.

INSANE AND FEEBLEMINDED IN INSTITUTIONS IN 1910. Department of Commerce, Bureau of the Census. Washington, D. C., Government Printing Office, 1914.

Statistics in regard to the insane and feebleminded in the United States in 1910 have been published by the Bureau of the Census, with an analysis by Joseph A. Hill. It is reported that the number of insane in institutions was 248,560, an increase of 25.1% over the figures for 1904, while the general population of the United States increased only 12% in that time. This indicates, in part, that more insane are being segregated, rather than that insanity is increasing so rapidly. A summary of laws relative to the care of the insane is presented. The number of feebleminded in institutions was 33,969, but there is reason to believe that the number in the United States is well above 200,000,—effective institutional segregation of the insane has gone far ahead of similar segregation for the feebleminded. Even of the small number of feebleminded who are in institutions, 40% are in almshouses.

A WORKING MODEL OF MENDELISM

W. BURNS

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ONE of the first things told to a student of Mendelian inheritance is that the distribution of characters is according to the law of chance: but to those who have not learned to think mathematically, chance in the abstract means little. I have, therefore, used the following method for the last five years to demonstrate the 3:1 ratio in the simplest case of Mendelian inheritance, and the way in which it is controlled by chance.

Take two packs of playing cards without jokers, each containing the usual fifty-two cards only. Put the red cards (hearts and diamonds) from both packs into one heap, and the black cards (spades and clubs) into another heap. These two heaps are now looked on as masses of male and female gametes, or germ-cells, of two plants (the supposition would hold equally for animals), one having a red character, and the other a black character.

If these two hypothetical plants are crossed, we have a black gamete uniting with a red gamete to make the zygote or fertilized egg-cell from which the new individual develops. To represent the cross, we take a card at random from each heap, as represented in Fig. 11.

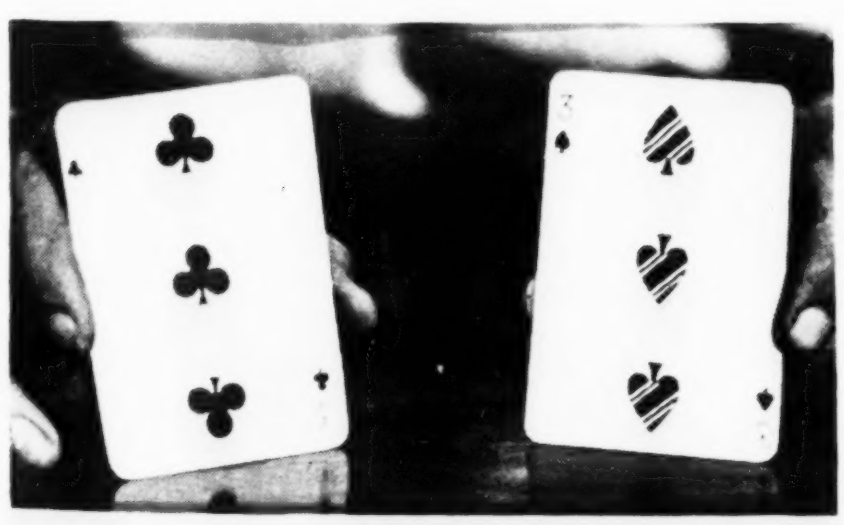


FIG. 11

As red and black cannot be well distinguished in a photograph, I have represented the red cards by black with white bars. These cards represent the parental generation.

Black is dominant in this cross; the hybrid produced from such a union therefore shows only the dominant character (black), the red being hidden behind it—recessive, to use the technical term. This is shown in Fig. 12; the red

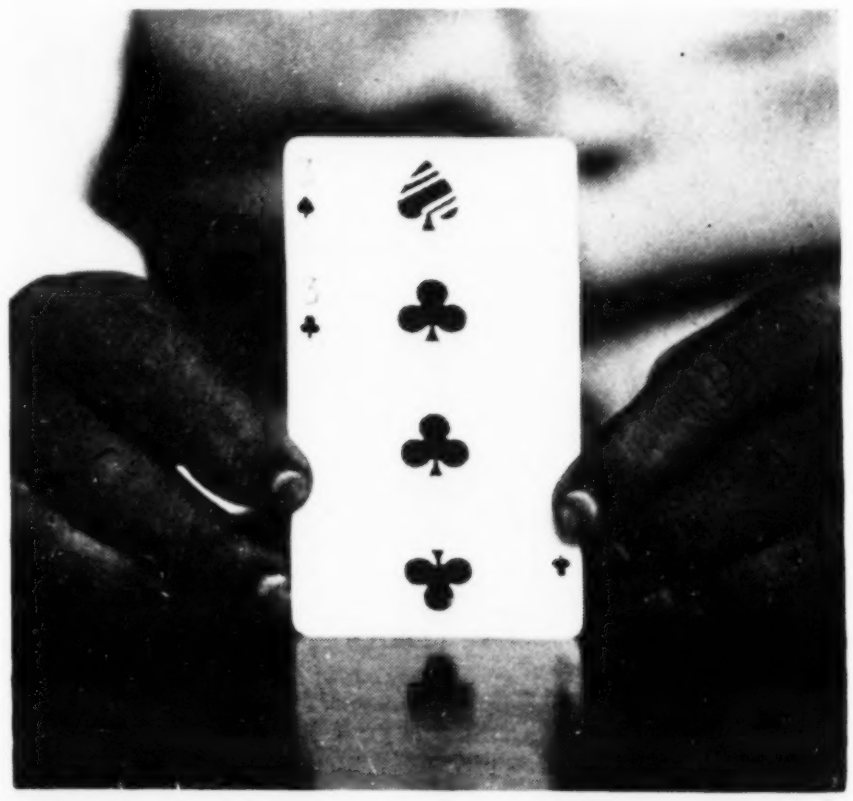


FIG. 12

has been allowed to stick up, in order that its existence may be seen. In the actual plant, the individual will show only the black, the red being wholly latent. This generation is designated as the first filial or F_1 generation.

We now assume that this hybrid plant of ours, showing the black dominant character, but still carrying the red as recessive, is self-fertilized. To illustrate the process of self-fertilization, make up both packs properly again, and shuffle each very thoroughly. Each pack will then consist of twenty-six red and twenty-six black cards, mixed

up anyhow. The right-hand pack represents the female gametes, and the left-hand pack the male gametes.

Now take up one card from the top of each pack, as shown in Fig. 13.

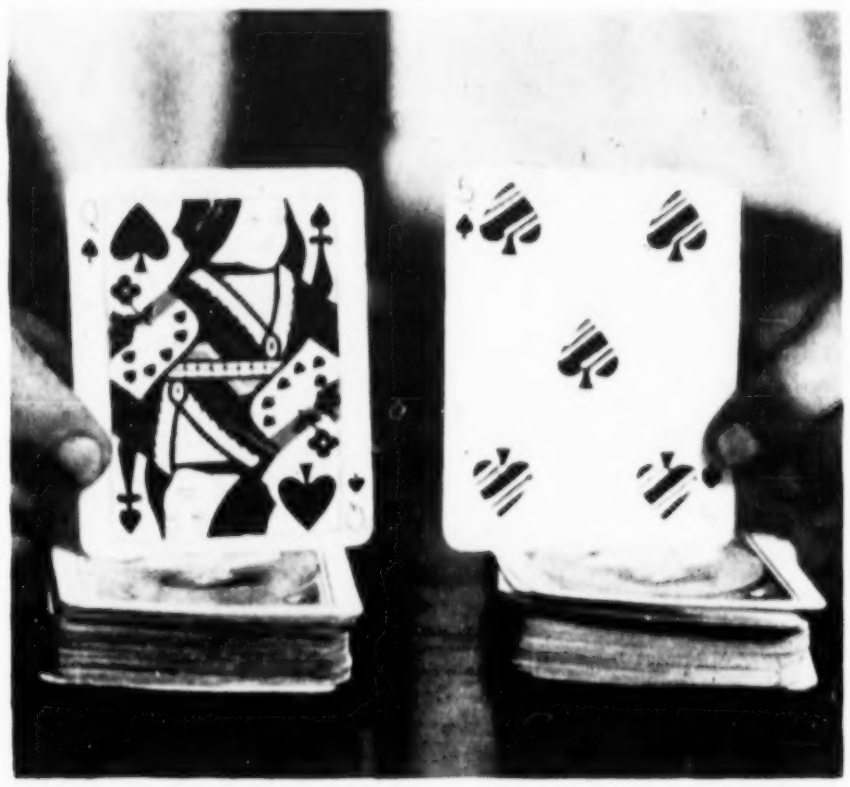


FIG. 13

There are four possible pairs which you can pick up in this way: Red Black, Red Red, Black Red and Black Black. Make four columns on the blackboard or a sheet of paper, with these headings, and put down a unit for every combination as it is taken up from the packs. If the cards have been thoroughly shuffled there will be thirteen units under each heading. If the cards have not been thoroughly shuffled, there may be a deviation: instead of 13, 13, 13, 13, we may get 12, 14, 14, 12, or something similar. If this occurs, shuffle the same packs and try again. I have always found that the ratio comes out correctly the second time.

Taking up the analogy again, we have the combination Black Black representing the pure dominants. Their germ-plasm has thrown out the red altogether and contains nothing but black; as long as they are self-fertilized, they will breed pure black generation after generation.

The next two combinations are Black Red and Red Black; but as black is dominant, it is evident that these will look and behave just alike, the black in each case concealing the red, which remains recessive or latent. These combinations are known to the Mendelist as heterozygotes, or impure dominants, while the pure black or pure red is called a homozygote.

Finally, the combination Red Red represents the pure (or "extracted," as it is often called) recessive. This line of germ-plasm has gotten rid of all the black, and will breed pure red indefinitely, provided it be self-fertilized and no new dominant introduced.

As to the heterozygotes, the Black Red and Red Black combination, it will be evident to the reader, if he thinks back over the whole process, that when they are *again* self-fertilized, they will again split up into the simple Mendelian proportion of three dominants (two of which are impure) to one recessive. And so the process goes on, generation after generation, where a single pair of contrasted characters (called "allelomorphs") is concerned, each generation seeing a segregation of the characters according to the law of chance, just as if the characters were shuffled about by Nature as we shuffle the cards; and each generation seeing a repetition of the famous 3:1 ratio.

Improving Native Grapes

Like several other southern States, Georgia is endeavoring to exploit the hardy native grape (*Vitis rotundifolia*), either through selection or hybridization. So far the work accomplished at the State Experiment Station has been preliminary, and devoted to a study of the behavior of the white scuppernong variety under carefully controlled conditions, so that its characters could be determined. The pecan, which has attained considerable importance in the South during recent years, is also under investigation, to determine why a number of trees are self-sterile, and what advantage lies in keeping such trees in an orchard.

EXTRA-FLORAL NECTARIES

OF THE many adaptations of flowers to secure that cross-pollination which ordinarily seems to be so advantageous to them, none is of more obvious use than the nectary. If it is desirable for the flower to attract insect visitors, surely nothing could be more attractive than a reservoir or fountain of nectar, from which they can drink.

Early botanists indeed were considerably puzzled by the case. Patrick Blair guessed that the honey absorbed the pollen and thus fertilized the ovary; Pontedera thought it kept the ovary in a moist condition: Linnaeus "gave it up;" "Krünitz thought he observed that in meadows much frequented by bees the plants were more healthy, but the inference he drew was, that the honey, unless removed, was very injurious, and that the bees were of use in carrying it off."

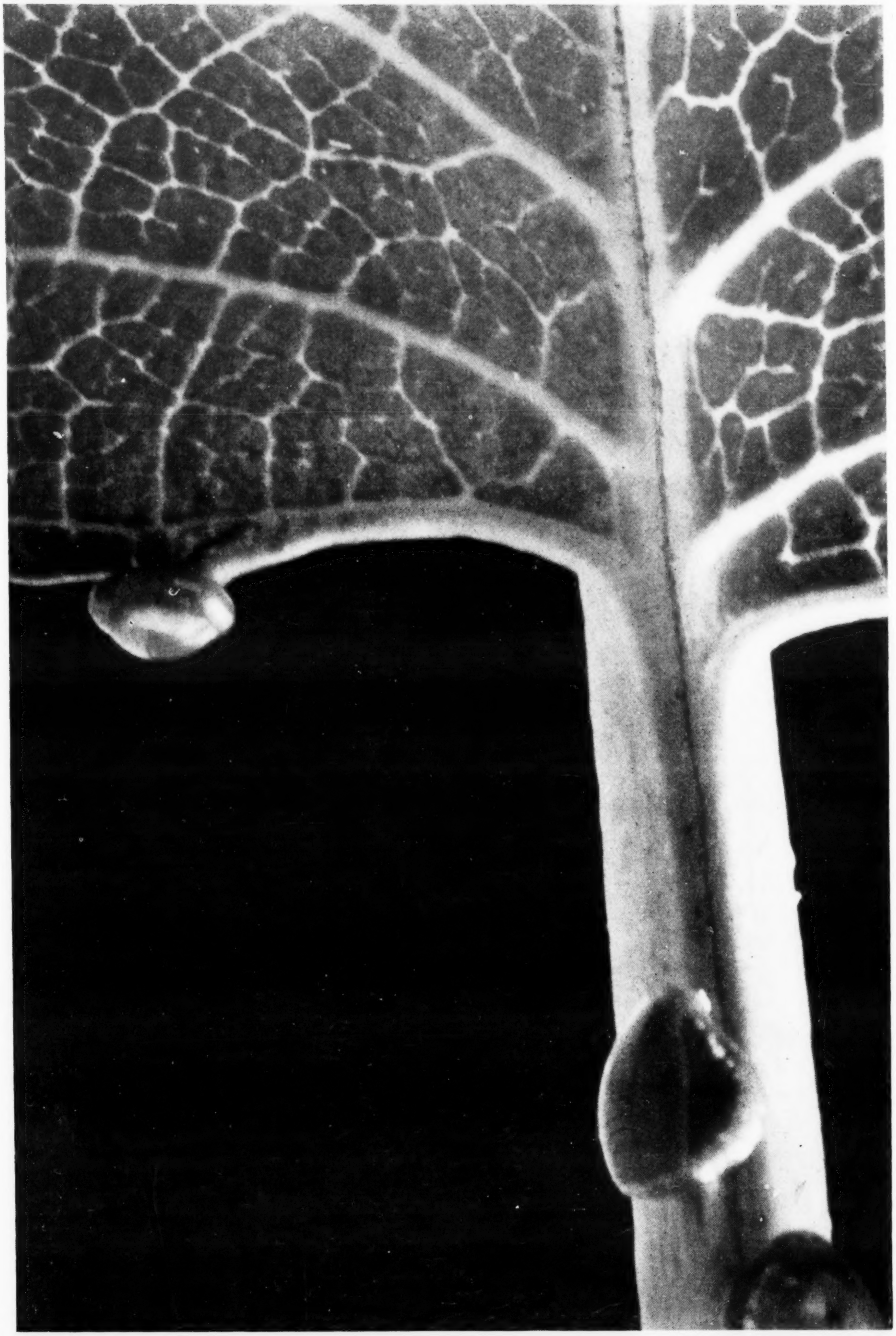
But since the cross-pollination of plants, and the part that insects play in it, have been understood, there has been little doubt as to the utility of nectaries in most flowers.

When, however, we come to nectaries outside the flowers, such as not a few plants possess, we are obliged to pause for consideration. Such nectaries can be seen to good advantage on the leaf-stem of any cherry, on the passion flowers (for example, the "may-pop," *Passiflora incarnata*, of the United States), on the cowpea and various other legumes, on the castor bean (*Ricinus communis*), and on many other less common plants. The accompanying photographs show the extra-floral nectaries at the base of cherry leaves, where there are usually two, and sometimes half a dozen, which may be not only on the petiole, but on the margin of the leaf itself.

The early Darwinian school of naturalists, who felt it necessary to find a purpose for the existence of *every* feature of an organism, in order to account for its development through natural selection, spent a good deal of ingenuity on the extra-floral nectary. In the numerous cases where this gland is on the flower-stem or close to the flower, it was suggested that its purpose was to act as a sort of "blind" for ants, which might otherwise enter the flower itself, in their search for honey, and thus self-pollinate it. If they found a nectary at the base of the flower, it was argued that the ants would satisfy their needs from it, and depart without upsetting the flower's plans for cross-pollination.

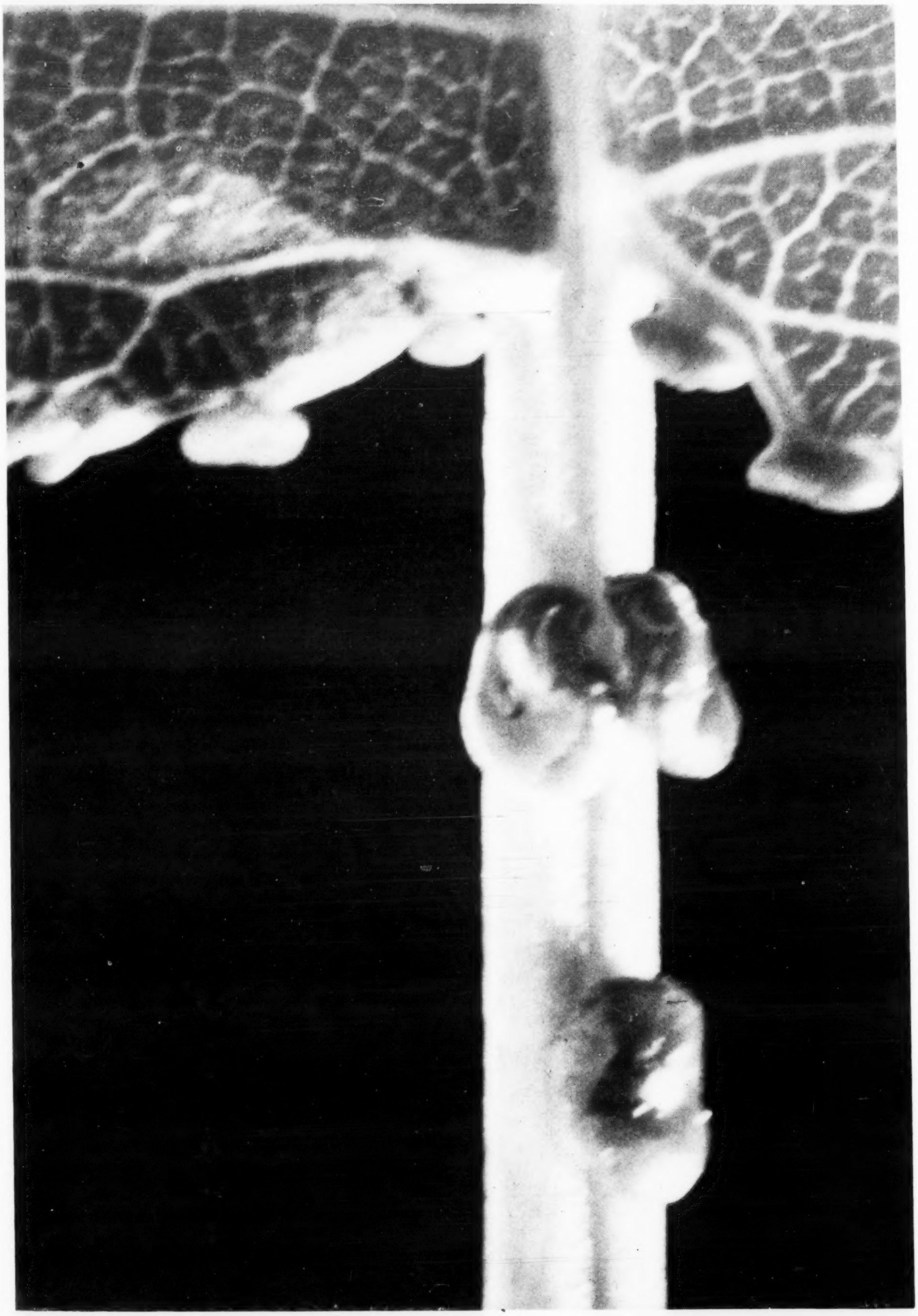
The idea that extra-floral nectaries were a special appeal to ants was developed most fully by Belt and Delpino, the former of whom about forty years ago published his description of the remarkable bull-horn acacias of Central America, in the huge spines of which colonies of ants make their homes, feeding on syrup from extra-floral nectaries, and paying for their entertainment by protecting the tree from all other living things. Describing these acacias, W. E. Safford writes: "The bi-pinnate leaves have nectar glands on the rachis and petiole, as in many other acacias and they are still further provided with peculiar processes on the tips of the leaflets, minute, wax-like bodies rich in oil and protoplasm, which Thomas Belt in his *Naturalist in Nicaragua* (1874) discovered to be used as food by the ants inhabiting the spines, and which in his honor were named Beltian bodies." F. Delpino, in a classical work on the subject (*Funzione mirmecofile nel regno vegetale*, 1886-9) brought together many other illustrations of these supposedly protective nectaries outside the flower proper, enumerating their occurrence in 3,030 species of 292 genera, of which 563 are in America. The greatest number is in the pea family (Leguminosae), closely followed by the Euphorbiaceae or spurge family.

Microscopical examination of these nectaries at various stages shows that their development takes quite different courses in different species. There



NECTARIES ON A CHERRY LEAF

Photograph showing, greatly enlarged, a portion of the flower edge and petiole or leaf-stem of a Japanese flowering cherry leaf. Projecting from the lower edge of the leaf, looking like a small acorn, is an extra-floral nectary. The acorn cup is the nectary and what looks like the acorn is a drop of nectar which has exuded and has not yet been lapped up by some hungry ant. Down on the leaf-stem are two more large nectaries. (Fig. 14.)



A CLUSTER OF EXTRA FLORAL NECTARIES

Nectar is ordinarily thought of as a product of flowers, but some plants also excrete it from leaves and stems. This photograph of a cherry leaf-stem gives a vivid idea of the profusion with which nectar-glands are sometimes formed outside the flower. Three large extra-floral nectaries can be seen on the stem, while the margin of the leaf bears half a dozen more, most of them not functional. When they are functional they are visited by ants and various other insects, but their presence seems to be of no particular advantage to the tree. Highly magnified. (Fig. 15.)

seems to be no single underlying principle governing their appearance. Their secretions also vary widely, although in general they give off merely a kind of sugar-water, containing varying proportions of dextrose, levulose and sucrose.

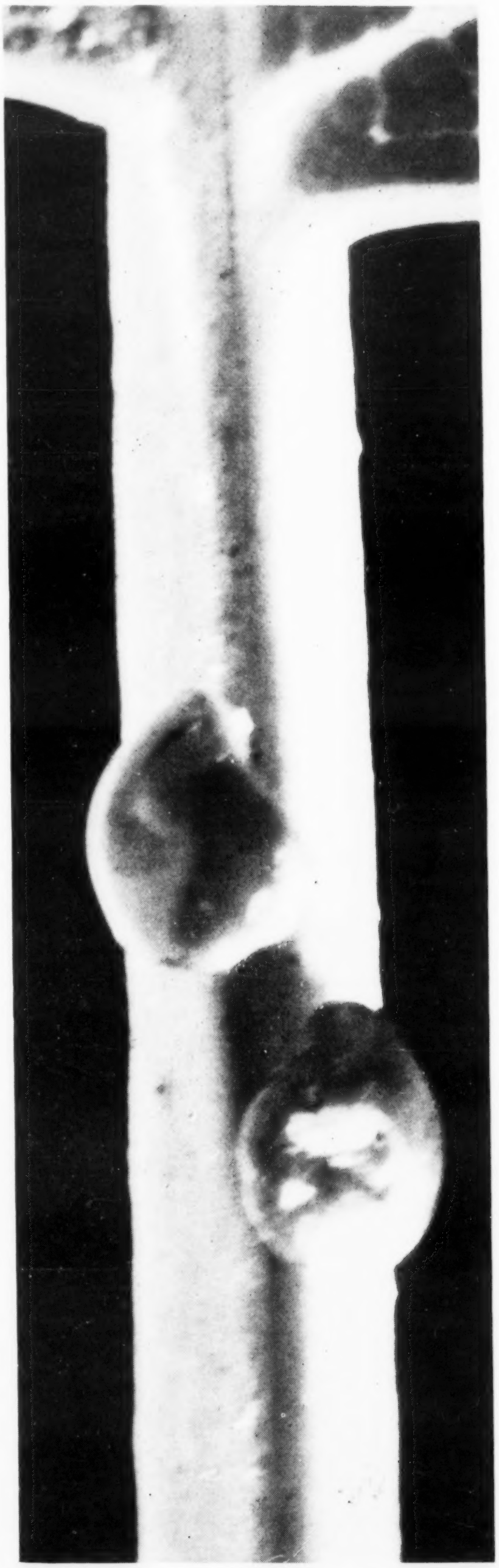
When, only a few years ago, naturalists generally began to realize that there might conceivably be parts of an organism which had no particular use, and that the appearance of such parts could be perfectly explained in various ways, without resorting to the principle of natural selection, and that their useless existence, further, would not cause the whole structure of organic evolution to totter on its foundation, the extra-floral nectaries began to be examined in a more critical way.

Numerous plants with extra-floral nectaries have been deprived of these organs, but it has been found that they produce the normal amount of seed just the same, and that none of their activities appears to be altered.

Further, it has appeared that plants which attract ants by extra-floral nectaries sometimes have their flowers more robbed by ants, than would probably be the case if they lacked extra-floral nectaries. The idea that the presence of such nectaries is a "sop" to divert the attention of ants from the greater treasures in the flowers, therefore, appears to have little basis in fact, as far as observation goes.

Again, in some of the broad beans (Vicia), it has been found that bees visit the extra-floral nectaries, in preference to those in the flower. In such cases, the flower may fail altogether to be cross-pollinated; evidently, then, the presence of extra-floral nectaries is in these cases a distinct disadvantage rather than an advantage to the plant.

Finally, the theory that nectaries outside the flower are intended to protect those inside the flower from unwelcome visitors, would seem to demand that the two sets of nectaries be functioning at the same time. But in point of fact, it has been observed that there is rarely exact correspondence in time, and that in some cases the chief secretion of extra-floral nectar occurs before, in others after, the period when



NECTARIES ON LEAF STEM

Photo-micrograph of cherry petiole, showing two typical extra-floral nectaries. (Fig. 16.)

the flower is open and seeking visits from its limited list of select visitors, for cross-pollination.

But the fact that extra-floral nectaries occur also on some ferns, *which have no flowers*, indicates most forcibly that the function of these structures is not necessarily to take part in the plant's schemes for avoiding self-fertilization.

If one must form a general theory covering all cases, it would seem that the most plausible in regard to the extra-floral nectaries is that they have no rôle of real importance. This idea would have shocked most of the early Darwinians, who would have felt it impossible to account for the origin of the structures, unless through their value to the plant in securing its survival. But most naturalists now agree that there are many structures in every plant and animal which have no conceivable function of real importance, and which can hardly have arisen and been maintained because of their survival-value. As to how such things originated, we are obliged sometimes to admit that "they just happen;" that there seems to be no particular reason. Once there, they remain; for, if they are of no particular advantage, neither are they of any particular disadvantage.

It is admittedly dangerous for Man to assume that he can understand all the ways of Nature and decide by his own standards whether or not a certain structure is of value to a plant. But so far as our observation can guide us, it appears that in many cases, at least, extra-floral nectaries must be looked on as little better than accidents in the development of the plant; they may, of course, have been more useful at some earlier stage in the plant's evolutionary history, but at present we can hardly avoid the conclusion in many cases that they have no vital function and that the plant would probably get along just as well without them.

Inheritance in Flowers

Two lines of experiment of strictly genetic interest have been undertake by the Pennsylvania Agricultural Experiment Station—namely, a study of the inheritance of flower form and color in *Phlox drummondi*, and a similar study in *Mirabilis jalapa*, the Four O'clock. Both these flowers are among the stock in trade of genetists; the latter is particularly rich in surprises. Correns, for instance, crossing a white with a cream-color, got eleven kinds of red, white, yellow and striped offspring among the grandchildren. In the cross of white and red Four O'clock occurs one of the classic examples of blended inheritance, the color of the hybrid generation being pink, while in most plants the color of one parent dominates in the hybrid generation to such an extent that it completely masks the other. The station is also attempting, in tobacco, to find why hybrids are sterile, particularly in cases where germination is low and where seedlings fail to mature.

Genetics in New Jersey

The New Jersey Agricultural Experiment Station, one of the pioneers in plant breeding, has the following projects under way: Inheritance of size and form in tomatoes; inheritance of pungency and of morphological characters in peppers; inheritance in crosses of popcorn with flint, dent and flour varieties, and in hybrid beans and egg plants, the object of the last project being to produce a true spineless commercial kind. A hybrid okra has been developed that may be of value as an ornament. Wide crosses are being made with the Prairie-berry (*Solanum nigrum?*). An interesting experiment under way is to test the correlation between variability and vigor in a population; while the inheritance of prolificness is being tested in beans, tomatoes, peppers and soy beans, one of the objects being to find out the value of barren plants in any population.

GENEALOGY AND EUGENICS

Study of Human Lineage Can Be Greatly Increased in Value if Illuminated by Genetics—Methods To Be Followed—Results To Be Expected.[1]

THE EDITOR

SCIENTIFIC plant breeders today have learned that their success often depends on the care with which they study the genealogy of their plants.

Live-stock breeders admit that their profession is on a sure scientific basis only to the extent that the genealogy of the animals used is known.

Human genealogy is one of the oldest manifestations of man's intellectual activity, but until recently it has been subservient to sentimental purposes, or pursued from historical or legal motives. Biology has had no place in it.

Genealogy, however, has not altogether escaped the re-examination which all sciences received after the Darwinian movement revolutionized modern thought. Numerous ways have been pointed out in which the science—for genealogy is certainly a science—could be brought into line with the new way of looking at Man and his world. The field of genealogy has already been invaded at many points by biologists, seeking the furtherance of their own aims.

I propose to discuss briefly the relations between the conventional genealogy and the modern application of biological principles to everyday life which, as it is here viewed, may be broadly described by the name Eugenics, "good breeding." It may be that genealogy could become an even more valuable branch of human knowledge than it now is, if it were more closely aligned with biology. In order to throw light on this possibility, we must inquire:

(1) What is genealogy?

(2) What does it now attempt to do?

(3) What faults appear, from the eugenist's standpoint, to exist in its present methods?

(4) What additions should be made to its present methods?

(5) What can be expected of it, after it is revised in accordance with the ideas of the eugenist?

The answer to the first question, "What is genealogy?" need not detain me long, for you are already more familiar with it than I am. Genealogy may be envisaged from several points. It serves history. It has a legal function, which is probably of more consequence abroad than in America. It has social significance, in bolstering family pride and creating a feeling of family solidarity—this is perhaps its chief office in the United States. It has, or can have, biological significance, and this in two ways: either in relation to the pure science or the applied science. In connection with pure science, its function is to furnish us means for getting a knowledge of the laws of heredity. In application, its function is to furnish a knowledge of the inherited characters of any given individual, in order to make it possible for the individual to find his place in the world and, in particular, to marry wisely. It is obvious that the use of genealogy in the applied science of eugenics is dependent on the preceding use of it in the pure branch of the science; for marriage matings which take account of heredity can not be made unless the laws of heredity have previously been discovered.

The historical, social, legal and other aspects of genealogy do not concern the present paper. I shall discuss only

[1] Address before the International Congress of Genealogy, San Francisco, Calif., July 26-31, 1915.

the biological aspect: first, because I am incompetent to discuss the others; and secondly, because I hold that the biological conception has by far the greatest true value, accepting the criterion of value as that which furthers the progressive evolution of the race. By this criterion, I believe the historical, legal and social aspects of genealogy are of secondary importance; the greatest worth it can possibly have is in coöperation with biology. This definition may appear to be a begging of the question of my whole paper; I shall attempt to justify it farther on.

(2) Genealogy now too often professes to be an end in itself. It can, of course, be looked upon as an end in itself, but I believe that it will be recognized as a science of much greater value to the world if it is admitted to be not an end but a means to a far greater end that it alone can supply.

It has, indeed, been contended, even by such an authority as Ottokar Lorenz, who is often considered the father of modern scientific genealogy, that a knowledge of his own ancestry will tell each individual exactly what he himself is. This, as I understand it, is the basis of Lorenz' valuation of genealogy. It is a step in the right direction: but

(3) The present methods of genealogy are inadequate to support such a claim. Its methods are still based on the historical, legal and social functions, and it has not yet begun, save in a few instances, to realize its almost incomparable opportunity for the betterment of mankind. Let me indicate just a few of the faults of method in genealogy, which the eugenist most deplores:

(a) The information which is of most value is exactly that which genealogy ordinarily does not furnish. Dates of birth, death and marriage of an ancestor are of interest, but rarely of real biological value. The facts about that ancestor which vitally concern his living descendant are the facts of his character, physical and mental; and these facts are given in very few genealogies.

(b) Genealogies are commonly too incomplete to be of real value. Sometimes they deal only with the direct male line of ascent—what animal breeders call the tail-male. In this case, it is not too much to say that they are nearly devoid of genuine value. Fortunately, American genealogies do not often go to this extreme, but it is not uncommon for them to deal only with the direct ancestors of the individual, omitting all brothers and sisters of those ancestors. Although this simplifies the work of the genealogist immensely, it deprives it of value to a corresponding degree.

(c) As the purpose of genealogy in this country has been largely social, it is to be feared that in too many cases discreditable data have been tacitly omitted from the records. The anti-social individual, the feebleminded, the insane, the alcoholic, the "generally no-count," has been glossed over. Such a lack of candor is not in accord with the scientific spirit, and makes one uncertain, in the use of genealogies, to what extent he is really getting all the facts. There are few families of any size which have not one such member or more, not many generations removed. To attempt to conceal the fact is an action of doubtful ethical propriety; but from the eugenist's point of view, at any rate, it is a falsification of records that must be regarded with great disapproval.

(d) Even if the information it furnishes were more complete, human genealogy would not justify the claims sometimes made for it as a science, because, to use a biological phrase, "the matings are not controlled." We see the results of a certain experiment, but we can not interpret them unless we know what the results would have been, had the precedent conditions been varied in this way or in that way. We can make these controlled experiments in our plant and animal breeding; we have been making them by the thousand, by the hundred thousand, for many years. We cannot make them in human society. Of course, we don't want to; but the point on which I wish to insist is that the biological meaning of human history, the real import of genealogy, cannot be known unless it is interpreted in the light of modern plant and animal breeding. It is absolutely

necessary that genealogy go into partnership with genetics, the general science of heredity: that it do not consider itself cheapened by an alliance with the plant and animal breeders. If a spirit of false pride lead it to hold aloof from these experiments, it will make slow progress. The interpretation of genealogy in the light of modern research in heredity through the experimental breeding of plants and animals is full of hope; without such light, it will be discouragingly slow work.

Genealogists are usually proud of their pedigrees; they usually have a right to be. But I beg of you, do not let your pride lead you to scorn the pedigrees of some of the peas, and corn, and snap-dragons, and sugar beets, and bulldogs, and Shorthorn cattle, with which genetists have been working during the last generation; for these humble pedigrees may throw more light on your own than a century of research in purely human material.

BIOLOGY NECESSARY

Your science will not have full meaning and full value to you, unless you bring yourselves to look on men and women as organisms subject to the same laws of heredity and variation as other living things. Biologists were not long ago told that it was essential for them to learn to think like genealogists. It is excellent advice and if I were speaking to biologists I would repeat it. As I am speaking to genealogists, I say with equal conviction that it is essential for genealogists to learn to think like biologists. For the purpose of eugenics, neither science is complete without the other; and I think it is not invidious for me to say that biologists have been quicker to realize this than have genealogists. The Golden Age of your science is yet to come.

(4) In addition to the correction of these faulty methods, there are certain extensions of genealogical method which could advantageously be made without great difficulty, I think.

(a) More written records should be kept, and less dependence placed on oral communication. The obsolescent family Bible, with its chronicle of births, deaths and marriages, is an institution of too great value to be given up, in more ways than one. In the United States, we have not the advantage of much of the machinery of State registration which European genealogy enjoys, and it should be a matter of pride with every family to keep its own archives.

(b) Family trees should be kept in more detail, including all brothers and sisters in every family, no matter at what age they died, and including as many collaterals as possible. This means more work for the genealogist, but the results will repay him.

(c) More family traits should be marked. Those at present recorded are mostly of a social or economic nature, and are of little real significance after the death of their possessor. But the traits of his mind and body are likely to go on to his descendants indefinitely. These are the facts of his life on which we should focus our attention. How this can be most conveniently done, I shall discuss later.

(d) More pictorial data should be added. Photographs of the members of the family, at all ages, should be carefully preserved. They are often of inestimable value. Measurements equally deserve attention. The door jamb is not a satisfactory place for recording the heights of children, particularly in this day when real estate so often changes hands. Complete anthropometric measurements, such as every member of the Young Men's Christian Association, most college students, and many other people are obliged to undergo once or periodically, should be placed on file.

(e) Pedigrees should be traced upward from a living individual, rather than downward from some hero long since dead. Of course, the ideal method would be to combine these two, or to keep duplicate pedigrees, one a table of ascendants and the other of descendants, in the same stock. This plan is not too laborious to use, in many cases; the combined tables, which show all the relatives of an individual, although attractive to the investigator, are too

complicated ever to become popular, I suspect.

THE IDEAL GENEALOGY

Genealogical data of the kind we need, however, can not be reduced to a mere table or family tree. The ideal genealogy, as described by Davenport,[2] starts with a whole fraternity—the individual who is making it, and all his brothers or sisters. It describes fully each member of this fraternity. "It then describes each member of the fraternity to which the father belongs and gives some account of their consorts (if married) and their children. It does the same for the maternal fraternity. Next it considers the fraternity to which the father's father belongs, considers their consorts, their children and grandchildren, and it does the same for the fraternities to which the father's mother belongs. If possible, earlier generations are to be similarly treated. It were more significant thus to study in detail the behavior of all the available product of the germ-plasms involved in the makeup of the first fraternity than to weld a chain or two of links through six or seven generations. A genealogy constructed on such a plan would give a clear picture of heredity, would be useful for the prediction of the characteristics of the generations yet unborn, and would, indeed, aid in bringing about better matings."

(5) With these changes, genealogy would become the study of heredity, rather than the study of lineage. Perhaps you will not all agree that this would be a desirable change; but I think if you can once get the biological, the eugenic point of view, you will realize that any other field for genealogy is too narrow.

I do not mean to say that the study of heredity is nothing more than applied genealogy. As we understand it nowadays, it includes mathematical and biological territory which must always be foreign to genealogy. I should prefer to put it this way: That in so far as Man in concerned, heredity is the interpretation of genealogy, and eugenics the application of heredity. But I do mean to say that genealogy should give its students a vision of the species as a great group of ever-changing, inter-related organisms, a great network originating in the obscurity of the past, stretching forward into the obscurity of the future, every individual in it organically related to every other, and all of them the heritors of the past in a very real sense.

No one is so well fitted as the genealogist to realize the solemn grandeur of Weissmann's doctrine that the germplasm is continuous from the beginning of existence on this world to the now unseen end. Our bodies, as you all have heard, are made up of two parts: this mass of highly differentiated cells which represent the man or woman, and which are destined to die when the individual shall have completed his three score years and ten, more or less; and within, the little mass of germ-cells, the undifferentiated, immortal or at least potentially immortal carriers of the heritage of the race. Generation after generation this germ-plasm goes on dividing; from parent to child it is passed on, unchanged save by the addition at each generation of a new line from the second parent. The body dies, but if the individual has left posterity, the germ-plasm lives after him. Immortality is, in this sense at least, a very real thing to the biologist; and I believe the genealogist would see a new meaning in his work if he kept the same conception in mind.

IMPORTANCE OF INDIVIDUALS

Genealogy does well in giving a realization of the importance of the family, but it errs if it bases this teaching altogether on the family pride in some remote ancestor who, even though he bore the family name and was a prodigy of virtues, probably counts for very little in the individual's makeup today. Let me take a concrete though wholly imaginary illustration: what man would not feel a certain satisfaction in being a lineal descendant of George Washington? And yet, if we place the

[2] Davenport, C. B. Heredity in Relation to Eugenics, p. 240. New York, Henry Holt & Co., 1911.

Father of his Country at only four removes from the living individual, nothing is more certain than that our hypothetical living individual had fifteen other ancestors in George Washington's generation, any one of whom may play as great or greater a part in his ancestry; and so remote are they all that, on statistical grounds alone, it is calculated[3] that the contribution of George Washington to the ancestry of our hypothetical living individual would be perhaps not more than one-third of 1% of the total.

I do not mean to disparage descent from a famous man or woman. It is a matter of legitimate pride and congratulation. But claims for respect made on that ground alone are, from a biological point of view, usually contemptible, if the hero is several generations removed. What Sir Francis Galton wrote of the peers of England may, with slight reserves, be given general application to the descendants of famous people:

"An old peerage is a valueless title to natural gifts, except so far as it may have been furbished up by a succession of wise intermarriages. . . . I cannot think of any claim to respect, put forward in modern days, that is so entirely an imposture as that made by a peer on the ground of descent, who has neither been nobly educated, nor has any eminent kinsman within three degrees."[4]

But, some one may protest, am I not shattering the very edifice of which I am a professed defender, in thus denying the force of heredity? Not at all. I wish merely to emphasize that a man has sixteen great-grandparents, instead of one, and that we too often overlook those in the maternal lines, although from a biological point of view they are every bit as important as those in the paternal lines. And I wish further to emphasize the point that it is the near relatives who, on the whole, represent what we are. The great family which for a generation or two makes unwise marriages, must live on its past reputation and see the work of the world done and the prizes carried away by the children of wiser matings. No family can maintain its place merely by the power of inertia. Every marriage that a member of the family makes is a matter of vital concern to the future of the family: and this is one of the lessons which a broad science of genealogy should inculcate in every youth.

QUALIFICATIONS FOR WORK

Is it practicable to direct genealogy on this slightly different line? As to that, I must allow you to judge; it would be presumptuous for me to express an opinion. Let me recall, however, the qualifications which old Professor William Chauncey Fowler laid down[5] as essential for a successful genealogist:

Love of kindred.
Love of investigation.
Active imagination.

[3] Galton's Law of Ancestral Heredity (which is purely statistical in nature and may be quite misleading when applied to individual cases) makes it possible to calculate the contribution of each ancestor, all the way to infinity. Pearson has modified this law, but as I cite it here only by way of illustration, I give Galton's original version for the sake of simplicity. Following is the calculation for the first six generations:

Generations	Number of Ancestors	Influence of Generation	Influence of Individual
1	2	50.	25.
2	4	25.	6.25
3	8	12.5	1.56
4	16	6.25	0.39
5	32	3.125	0.10
6	64	1.5625	0.024

[4] Galton, Francis. Hereditary Genius, p. 87. London, The Macmillan Company, 1869.
[5] Fowler, William Chauncey. Conditions of Success in Genealogical Investigations. N. E. Hist. and Gen. Soc., Boston, 1866.

Sound and disciplined judgment.
Conscientious regard to truth.
A retentive memory.
A pleasing style as a writer.

With such qualifications, one can go far, and I venture to express the opinion that one who possesses them has only to fix his attention upon the biological aspect of genealogy, to become convinced that his science is only part of a science, as long as it ignores eugenics. After all, nothing more is necessary than a slight change in the point of view; and if genealogists can adopt this new point of view, can add to their equipment some familiarity with the fundamental principles of biology as they apply to man and are laid down in the science of eugenics, I am firmly of the conviction that the value of the science of genealogy to the world will be increased at least five-fold within a generation.

Let us examine a little more closely what can be expected from a genealogy with eugenic foundation.

First and foremost, it will give genetics a chance to advance with rapidity, in its study of man. Genetics, the study of heredity, cannot successfully proceed by direct observation in the human species as it does with plants and rapidly-breeding animals because the generations are too long. Less than three generations are of little value for our researches, and even three can rarely be observed to advantage by any one person. Therefore, second-hand information must be used. So far, we have gained most of this by sending field-workers—a new kind of genealogist—out among the people in whom we are interested, and having them collect the information we wanted, either by study of extant records, or by word of mouth. But the written records of value have been usually negligible in quantity, and oral communication has therefore been our mainstay. It has not been wholly satisfactory. Few people—aside from genealogists—can give even the names of all their great-grandparents, far less can they tell anything of importance about them.

It is thus to genealogy that we are driven. Unless we have family records we can accomplish little. And we cannot get these family records unless you genealogists realize the importance of furnishing them; for as I have already pointed out, and as I wish to emphasize, genealogies at present available are of little value to genetics, because of the inadequacy of the data they furnish. It is only in the case of exceptional families, such as the royal houses of Europe, that enough information is given about each individual to furnish an opportunity for analysis. What could be done if there were more such data available is brilliantly illustrated by the investigation[6] of Dr. Frederick Adams Woods of Boston of the reigning houses of Europe. I commend his writings to every genealogist, as a source of inspiration as well as information.

HOPE FOR QUICK RESULTS

To get more such data, we must look to the future. We must begin at once to keep our family records in such a way that they will be of the greatest value possible—that they will serve not only family pride, but bigger purposes. It will not take long to get together a large number of family histories, in which the idea will be to tell as much as possible, instead of as little as possible, about every individual mentioned. Let me run over a few of the problems on which such genealogies would throw light.

There is the important problem of the inheritance of longevity. Karl Pearson showed[7] some years ago, by advanced statistical methods, that longevity is inheritable. Dr. Alexander Graham Bell, whose investigation of the ancestry of congenital deaf persons at Martha's Vineyard and elsewhere, more than a generation ago, was one of the first pieces of biological genealogy executed in this country, and indubitably estab-

[6] Woods, Frederick Adams. Mental and Moral Heredity in Royalty. New York, Henry Holt & Co., 1906; also The Influence of Monarchs. New York, The Macmillan Co., 1914.

[7] Pearson, Karl. Royal Society of London, Phil. Trans., vol. 192A, p. 277: Biometrika, vol. I, p. 74. London, 1903.

lished the heritable nature of congenital deafness[8]—Dr. Bell is now working on the published history of the Hyde Family in the United States, and analyzing it from many points of view to bring to light the ways in which longevity is inherited. It is obvious that this trait is a particularly easy one for investigation, because we need to know nothing more than the dates on which an individual and his parents were born and died. Certainly a genealogy that does not tell so much, must be considered defective; and yet of the 8,000 or more persons listed in the Hyde genealogy, there are less than 3,000 for whom these data are complete.

Longevity being due more to heredity than to anything else, it is evident, as Dr. Bell has clearly pointed out, that it is a trait of which families may well be proud, if it runs consistently in their stock. And, as we eugenists try as far as possible to put our knowledge to practical use, he has also pointed out that it is very desirable for a young man or young woman to marry into a family possessing that trait, since it is a good indication of general soundness of constitution and physical vigor. Families in whose ancestry longevity is a characteristic can well afford to make the fact known and take pride in alliance with other worthy families similarly endowed.

Such a mating, like with like, is technically known to us as assortative. It used to be supposed that people tended to marry their opposites—the blonde and the brunette, the short and the tall. The use of exact methods in eugenics has demonstrated that the reverse is the case, and that for almost every measurable trait there is distinct evidence of assortative mating.[9] That such a fact is of great value to the race, when the character involved is one of so much importance as longevity, is obvious, and the tendency should be encouraged. Genealogy can give much help in this connection.

There are certain phases of the always interesting problem of sex-determination on which genealogy can easily throw light. It has sometimes been asserted that the age of the parents influences the sex of the offspring. We do not know that this is so, but with the help of genealogy we might find out.

Another question of great practical importance, on which we seek information, relates to the posterity of men of genius. Is there any truth in the idea that their mental activity tends to use up some vital force, with the result that they are either sterile or leave posterity of mediocre quality? The idea does not sound convincing, but we shall not dismiss it dogmatically; we shall appeal to genealogy for data on which to dispose of it definitely. Of course the alleged fact here must not be confused with the well-known fact of regression, formulated as a mathematical law by Galton. We know that, on the average, the children of superior parents will tend to be inferior to their parents, and the children of parents who are below normal will tend to be a little better than their parents. This is due to the vast bulk of their remote ancestry, most of which is necessarily average or, as the statistician puts it, mediocre. The drag of this more remote heredity tends to pull every child toward mediocrity, or the mean, the average of the race. I must emphasize the fact that this is purely a statistical law, applying only to a quantity of cases, and is frequently untrue for individual cases.

The results of early as compared with late marriage offer another big problem, in the solution of which we need your help.

That the first-born children are, on the whole, inferior to the brothers or sisters who come after them has been asserted in recent years, and the assertion has been supported by a good deal of evidence. It is highly important that a much greater body of evidence be brought together on this point, and

[8] Bell, Alexander Graham. Memoir upon the Formation of a Deaf Variety of the Human Race. Washington, D. C., National Academy of Sciences, 1884.

[9] For a summary see Harris, J. Arthur. Assortative Mating in Man. Popular Science Monthly, LXXX, No. 5, pp. 476-493, New York, May, 1912.

here genealogy can aid with very little trouble. Unfortunately, it is not uncommon to find in the earlier generations of a family tree that the exact birth-rank of the various children is not designated; nor is account always made of infant deaths or still-births, as should certainly be done in every case.

The question of consanguineous marriage is one in which every genealogist is certain to have taken an interest, merely because of the doubling up of a name in his chart, if not from a biological point of view. Until recently, the question of the marriage of kin was debated largely by an appeal to dogma. I daresay every genealogist has seen cases where the marriage of first cousins was followed by good progeny, and equally cases where the result was bad. There is plenty of evidence of that sort to be had on both sides. I think it is safe to say that genetics has established the status of consanguineous marriage beyond all dispute. It certainly is not bad in itself, although first cousins are forbidden by law to marry in a third of the States of the Union.[10] It simply results in a doubling up of the traits which the two may have in common. If these traits are good, the children get a double dose of them, and will be more highly endowed than their parents. If the traits are bad, the children equally get a double dose of them, and may far surpass their parents in worthlessness, or in the prominence of any particular defect. The general conclusion is clear to us: marriages between cousins or other relatives of equal consanguinity, should not be condemned offhand, but the facts should be taken into consideration in each individual case. And it should be borne in mind, of course, that a trait may be latent or concealed in each of the cousins, but come into expression in their children. Although cousin marriages, therefore, should be scrutinized closely, we certainly find no reason to forbid them when the contracting parties are of sound stock.

The question of the inheritance of disease is one of great importance, which can be studied very easily through genealogy. Of course, no one with a knowledge of modern work in genetics now believes that diseases are truly inherited as such; but there is a great deal of evidence to show that what the doctors call a "diathesis," a predisposing tendency to some disease, may be inherited. Greater research is urgently needed to find the extent and limits of such inheritance, and it is to enlightened genealogy that we must look for the solution of the problem—or rather, problems, since there are as many problems as there are diseases, defects and abnormalities. We must not draw hasty generalizations, but attack each subject separately. We have pretty good evidence, for instance, that the tubercular diathesis is inherited: that the white plague ravages some families and leaves others untouched; that almost every city-dweller, at least, is at some time or other during his life infected with phthisis, and whether he resists or succumbs depends on his heredity. Herein lies guidance for those who would marry: other things being equal, let them avoid the weak stocks, the stocks known to be marked by tuberculosis. But because tuberculosis is thus a matter of heredity, it does not necessarily follow that cancer, or any other disease, is. We must take nothing for granted; we must find out by examining many families in which a given disease or abnormality occurs. And to do this, we must depend on the data of genealogy.

Here, however, let me utter an emphatic warning against superficial investigation. The medical profession has been particularly hasty, many times, in reporting cases which were assumed to demonstrate heredity. The child was so and so; it was found on inquiry that the father was also so and so: *post hoc, ergo propter hoc*—it must have been heredity. Such a method of investigation is calculated to bring the science of genetics into disrepute, and might easily ruin the credit of the science of genealogy, should genealogy allow itself to be so misled. As a fact, one case counts for practically nothing as

[10] Davenport, C. B. State Laws Limiting Marriage Selection, p. 14. Eugenics Record Office Bull. No. 9, Cold Spring Harbor, Long Island, N. Y., June, 1913.

proof of hereditary influence; even half a dozen or a dozen may be of no significance. There are two ways in which we can analyze genealogical data to deduce biological laws: one is based on the application of higher mathematics to mass statistics, and needs some hundreds of cases to be of value; the other is by pedigree-study, and needs at least three generations of pedigree, usually covering numerous collaterals, to offer any certain results. Not all the findings announced even by professional eugenists have met one or other of these requirements, and to the extent in which they have fallen short, they are being discredited. It is not to be supposed that anyone with a sufficiently complete record of his own ancestry would necessarily be able by inspection to deduce from it any important contribution to science. But if enough complete family records are made available, the professional genetist can be called into coöperation, can supplement the human record with his knowledge of the results achieved by carefully controlled animal and plant breeding, and between them, the genealogist and the eugenist can in most cases arrive at the truth. That such truth is of the highest importance to any family, and equally to society as a whole, must be evident.

SEX-LINKED INHERITANCE

The whole question of sex-linked inheritance depends for its solution on the extension of genealogical material. It is often said that sons take after their mothers, while daughters tend to resemble their fathers. The Arabs and Hebrews put the same idea a little differently, that a son tends to resemble his maternal uncle. Is there anything in these ideas? In a small way, there is no mystery about it; we know that certain hereditary traits are sex-linked—that they *are carried by* one sex but *appear* in the other. Thus, it is rare to find women who are color blind, but a woman who does not show this defect herself may have inherited it from her father, who was visibly affected, and transmit it to her sons, who will also be visibly affected. Extending this principle, it is easy to see that a boy might inherit some traits from his mother, which his father wholly lacked, and that a daughter might similarly receive exclusive traits from her father. I must say that sex-linked heredity in the human race has so far been definitely proved only in regard to color-blindness, hemophilia, and a few other abnormal conditions; but with the coöperation of the genealogists it is probable that we will find this condition, as important as it is interesting, to prevail more widely.

The problem of the inheritance of fecundity can obviously be settled only through proper genealogical material. It is known that fecundity is to some extent an inherited character, although doubtless affected in Man largely by outward circumstances. The voluntary limitation of births, which has become so widespread during the last generation, of course complicates the study of this subject, but there is nevertheless room for much work of a distinctly practical kind. Obviously, one of the easiest ways to improve the general average of the race would be to have high fecundity in the superior stocks and low fecundity in the inferior ones. It is equally obvious that if fecundity is associated with inferiority—with feeble-mindedness, for example,–that disastrous results will ensue if Nature is allowed to "take its course." The genealogist can contribute indispensable material for this study, and for the general study of the birth-rate in various sections of the community at various periods—a study which is the very foundation of applied eugenics.

Frederick S. Crum's work[11] on published genealogies of New England families shows what can be done in this line. From his material, Crum was able to get figures for 12,722 wives, and he found that the number of children per wife had decreased as follows:

1750-1799	6.43
1800-1849	4.94
1850-1869	3.47
1870-1879	2.77

[11] Crum, Frederick S. The Decadence of the Native American Stock. Quarterly Pub. American Statistical Assn., XIV, n. s. 107, pp. 215-223. Sept., 1914.

Before 1700, less than 2% of the wives had only one child each; nowadays the percentage is about 20. The percentage of wives, in his records, who are absolutely childless, has increased as follows:

1750-1799	1.88
1800-1849	4.07
1850-1869	5.91
1870-1879	8.10

He finds, on analysis of the most recent material, that the New England wives of the present day, representing the old colonial stock, have an average of 1.92 living children each, while the foreign-born mothers in the same districts have 3.01. We are accustomed to point with pity at France as a nation committing race suicide, with more deaths than births; as a fact, the old American stock in New England is dying out more rapidly, through race suicide, than is the population of France. Unless a change takes place, the stock which has furnished most of the genealogies and a large part of the great men and women of America is doomed to perish.

The inheritance of the tendency to produce twins is an interesting trait, not without practical as well as theoretical importance, which could probably be solved were a sufficient number of well-kept family trees made available for study. It is known that twinning is largely a matter of heredity, although the exact manner in which the tendency is inherited is still obscure. A good example of the danger of hasty generalization is furnished by the announcement made by some enthusiastic investigator a few years ago[12] that he had found a number of cases which made it evident to him that the tendency to twinning was due to the father rather than the mother. As ordinary twins are due to the production of two ova instead of one, and as the production of ova can hardly be denied to be a function of the mother rather than the father, the claim is absurd. Yet it is possible that a tendency to twinning might be sex-linked and transmitted through a father to his daughters, as has recently been asserted to be the case with high egg production in hens. Whatever the solution may be, it still lies hidden in pedigrees which the genealogist will make, or is already making.

DATA ON ALL TRAITS WANTED

But this list might grow interminably: for properly kept genealogical records will furnish material, without further trouble, for attacking very nearly all the problems in human heredity that are conceivable. The compiler of family histories need only include every physical or mental trait possible, bearing in mind that the genetist will ask two questions about it:

Is this characteristic inherited?

If so, how?

Nor must it be forgotten that we are often as much interested in knowing that a given character is *not* inherited under certain conditions, as that it is.

It is highly desirable that genealogists should acquire the habit of stating the traits of their subjects in quantitative terms. We are too often told that a certain amount is "much;" what we want to know is *how much*. Thus, instead of saying that an individual had fairly good health, tell exactly what diseases he had during his lifetime; instead of remarking that he was a good mathematician, tell us some anecdote or fact that will allow us to judge the extent of his ability in this line. Did he keep record of his bank balance in his head instead of on paper? Was he fond of mathematical puzzles? Did he revel in statistics? Was the study of calculus a recreation to him? Did he solve to his own satisfaction the problem of squaring the circle? Such things probably will appear trifles to the genealogist, but to the eugenist they are precious.

Aside from biology, or that phase of it which we call eugenics, genealogy may also serve medicine, jurisprudence, sociology, statistics, and various other sciences as well as the ones which it now serves. But in most cases, such service will have a eugenic aspect. The alliance between eugenics and genealogy is so logical that it cannot be put off much longer.

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[12] Cited by Weinberg, W. Methode der Vererbungsforschung beim Menschen. Berliner Klinische Wochenschrift Vol. 49, 1912; No. 14, pp. 646-649 (April 1) and No. 15, pp. 697-701 (April 8).

You may well ask what facilities we have for receiving and using pedigrees such as I have been outlining, if they were made up. You are all, of course, familiar with the repositories which the different patriotic societies, the National Genealogical Society, and similar organizations maintain, as well as the collections of the Library of Congress and other great public institutions. Anything deposited in such a place can be found by the investigators, mostly attached to colleges and universities, who are actively engaged in eugenic research.

In addition to this, there are certain establishments founded for the sole purpose of analyzing genealogies from a biological or statistical point of view. The first of these was the Galton Laboratory of the University of London, directed by Karl Pearson. I shall not take time to mention the European institutions, but shall call to your attention the two at work in the United States.

The larger is the Eugenics Record Office at Cold Spring Harbor, Long Island, New York, directed by Dr. Charles B. Davenport, and maintained largely through the generosity of Mrs. E. H. Harriman. Blank schedules are sent to all applicants, in which the pedigree of an individual may be easily set down, with reference particularly to the traits of eugenic importance. When desired, the office will send duplicate schedules, one of which may be retained by the applicant for his own files. The schedules filed at the Eugenics Record Office are treated as absolutely confidential, access to them being given only to accredited investigators.

The second institution of this kind is the Genealogical Record Office, founded and directed by Dr. Alexander Graham Bell at 1601 Thirty-fifth Street NW., Washington D. C. This devotes itself solely to the collection of data regarding longevity, and sends out schedules to all those in whose families there have been individuals attaining the age of 80 or over. It welcomes correspondence on the subject from all who know of cases of long life, and endeavors to put the particulars on record, especially with reference to the ancestry and habits of the long-lived individual.

DUTY OF THE INDIVIDUAL

Persons intelligently interested in their ancestry might well consider it a duty to society, and to their own posterity, to send for one of the Eugenics Record Office schedules, fill it out and place it on file there, and to do the same with the Genealogical Record Office, if they are so fortunate as to come of a stock characterized by longevity. The filling out of these schedules would be likely to lead to a new viewpoint of genealogy; and when this viewpoint is once gained, I am satisfied that the student will find it adds immensely to his interest in his pursuit.

You are all familiar with the charge of long-standing, that genealogy is a subject of no use, a fad of a privileged class. I do not need to tell you that such a charge is untrue. But I think that genealogy can be made a much more useful science than it now is, and that it will be at the same time more interesting to its followers, if it ceases to look on itself as an end in itself, or solely as a minister to family pride. I hope to see it look on itself as a handmaid of evolution, just as other sciences are coming to do; I hope to see it link arms with the great biological movement of the present day; I hope to see the two of them working in close harmony, for the betterment of mankind.

So much for the science as a whole. What can the individual do? Nothing better than to broaden his out-look so that he may view his family not as an exclusive entity, centered in a name, dependent on some illustrious man or men of the past; but rather as an integral part of the great fabric of human life, its warp and woof continuous from the dawn of creation and criss-crossed at each generation. When he gets this vision, he will desire to make his family tree as full as possible, to include his collaterals, to note every trait which he can find on record, to preserve the photographs and measurements of his own contemporaries, and

to take a pride in feeling that the history of his family is a contribution to human knowledge, as well as to the pride of the family.

If the individual genealogist does this, the science of genealogy will become a splendid servant of the whole race, and its influence, not confined to a few, will be felt by all, as a positive, dynamic force helping them to lead more worthy lives in the short span allotted to them, and helping them to leave more worthy posterity to carry on the names they bore and the sacred thread of immortality, of which they were for a time the custodians.[13]

[13] Since the above was written, the Eugenics Record Office has published Bulletin No. 13 on "How to Make a Eugenical Family Study." It gives details of procedure which will be of much help to any one interested in eugenic genealogy.

Big Tree Photograph Contest

Because of the large number of entries received at the close of the Big Tree photograph contest (more than 200 arriving during the final ten days of the offer), the Association officials were unable to make an announcement of the result, in time for this issue. The full results will be printed in the September issue.

Stammering and Heredity

Stammering is largely due to heredity, according to Dr. G. Hudson Makuen, who presents a study of 1,000 cases in the *Volta Review* (July, 1915).

"Thirty-nine per cent. of my patients," he says, "admitted having or having had relatives who stammered, and this percentage is probably too low, because there is always a tendency to conceal the facts in matters of this sort, and because stammering probably existed in some of the families without the knowledge of the patients.

"Stammering is an affection that develops with the development of the speech of the individual, and it develops chiefly in those children who have inherited, or it may be acquired, the physical anomalies which make the development of the affection possible or even probable. These anomalous cerebral conditions which give rise to stammering may be transmitted from parents who themselves may not have stammered, but who possessed all the cortical conditions which usually result in the affection and only escaped it through more favorable environmental surroundings."

Inheritability of Cancer in Mice

Cancer in mice is due to the inheritance of a tendency or "diathesis" which behaves as a Mendelian recessive, according to Maud Slye (*Journal of Medical Research*, XXXII, 1, March, 1915). "Among over 9,000 autopsies, yielding more than 500 cases of spontaneous cancer in this laboratory (Otto S. A. Sprague Memorial Institute, University of Chicago), the cancers almost without exception have occurred in strains of known cancerous ancestry." Some evidence is offered that this regular appearance of the disease in certain strains, and not in others, cannot be due to infection. It is stated that mouse cancer is not distinguishable from human cancer. The author concludes, "Cancer is not transmitted as such, but rather as a tendency to occur from a given provocation, probably in the form of over-irritation. The elimination as far as possible of all forms of over-irritation to the tissues of an individual of high cancer ancestry should go far to eliminate the provocation of cancer; and the eugenic control of matings so that cancer shall at least not be potential in both sides of the hybrid cross ought to eventuate in a considerable decrease in the frequency of human cancer."

THE SOUTH AMERICAN TRAVELER'S PALM

View in the botanic garden of Rio de Janeiro, Brazil, showing at the left several tall, fan-like specimens of the South American Traveler's Palm (*Ravenala guianensis*), a relative of the banana. The palm derives its name from the fact that rain water collects at the bases of the leaves, where the thirsty traveler is said to find and drink it, when no other source is available. The account is more picturesque than true, perhaps, since the plant grows only in regions which are naturally well watered, and since the water which does collect at the base of the leaves is usually putrid and full of mosquito larvae. At the right of the photograph is a graceful specimen of Acrocomia, one of the most beautiful of the native South American palms. (Fig.17.)